LEARNING ASSESSMENT OF DIGITAL LIBRARY TECHNIQUES: USABILITY. EFFECTIVENESS EFFICIENCY SATISFACTION AND LEARNABILITY

THESIS

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By

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This is to certify that as per the minutes of the CASR held on 24/08/2012, the necessary corrections/modifications as pointed out by the Foreigner examiner have been made by the candidate Gamal Ahmed Ahmed Abdullah and incorporated in the thesis titled ***Learning Assessment of Digital Library Techniques: Usability, Effectiveness, Efficiency, Satisfaction and Learnability***.

I, as supervisor, certify that I have gone through the corrections done by the candidate and I am satisfied with the modifications incorporated in the thesis as per the observations of the Foreigner examiner.

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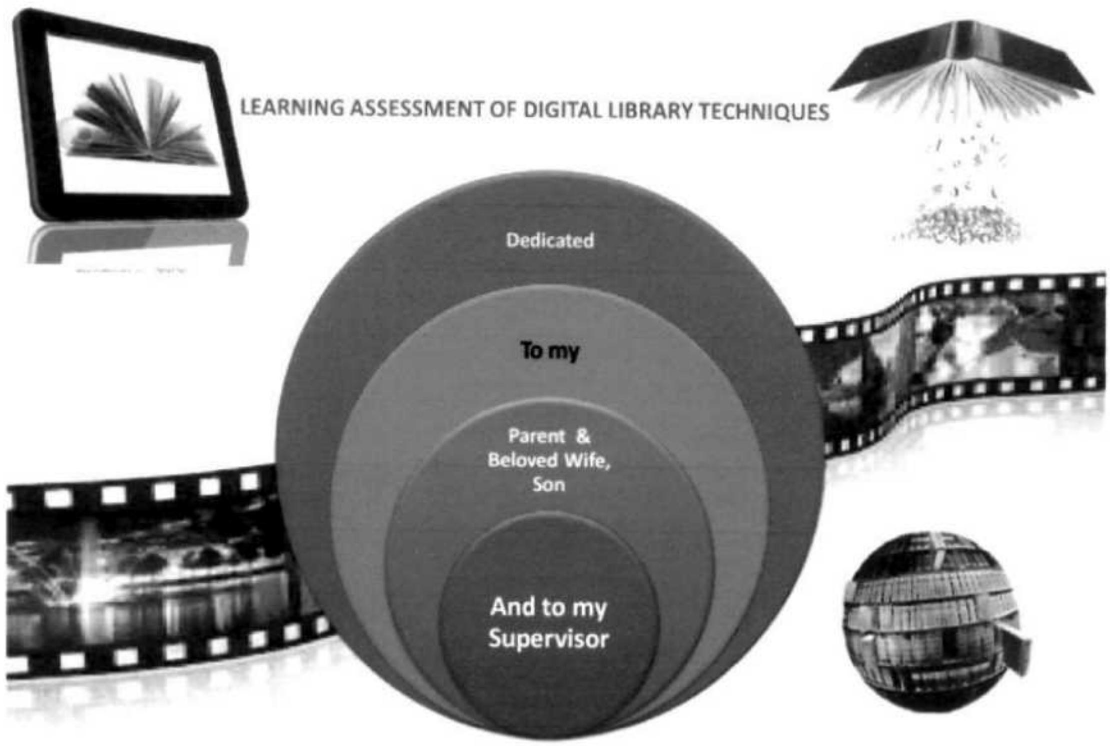
LEARNING ASSESSMENT OF DIGITAL LIBRARY TECHNIQUES
Dedicated
To my
Parent &
Beloved Wife,
Son
And to my
Supervisor

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RESEARCH PUBLICATIONS

1. Nasreen AzizulHaq, N.; Abdullah Alawi, G. A. A. (2010). Various learning courses based on digital library conceptualization. *In Proceeding of IEEE Second International Conference on Technology for Education*, pp. 230-231. IIT Bumbai, Mumbai, Maharashtra, India. URL:
   http://www.computer.org/portal/web/csdl/doi/10.1109/T4E.2010.5550099

   Or: http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=5550099

2. Nakhat Nasreen, Gamal Ahmed Ahmed Abduulah (2010). Learning assessment of multimedia techniques based on digital library conceptualization. *In Proceedings of IEEE Third International Conference on Education Technology and Training,* (ETT 2010), Volume 1, pp. 357-360. Wuhan, China. URL:
   http://cpfd.cnki.com.cn/Article/CPFDTOTAL-ZNXX201011005096.htm

3. Nakhat Nasreen, Gamal Ahmed Ahmed Abduulah (2011).Dynamic online learning based on multimedia techniques of digital libraries applications. *In Proceeding of 2011 International Conference on Open Distance Learning for Social Justice*, pp.66-67. Center for Distance Education, Aligarh Muslim University, Aligarh, India.

4. Nasreen, N; Alawi, G. A. A. A. (2011). Impact of digital library and Internet technology on learner's usability and satisfaction. *In Proceeding of 2011 of IEEE Third International Conference on Technology for Education,* (T4E 2010), pp. 128-135. IIT Madras, Chennai, Tamil Nadu, India. URL:
   http://www.computer.org/portal/web/csdl/doi/10.1109/T4E.2011.28

   Or: http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=6004372

5. NakhatNasreen AzizulHaq and Gamal Ahmed Ahmed Abdullah (2012). Synchronous Information Technology Applications: Impact of QoL & WB on Education Online. Universal Journal of Education and General Studies Vol. 1(2) pp. 033-043. URL:
   http://universalresearchjournals.org/ujegs/pdf/2012/Feb/AzizulHaq%20and%20Alawi.pdf

6. NakhatNasreen AzizulHaq and Gamal Ahmed Ahmed Abdullah (2012). Impact of Information Technology on Quality of Life and Well – Being of Secondary School Children. International Journal of Psychology and Behavioral Sciences 2012, 2(4): 94-102. URL:
   http://www.google.co.in/url?sa=t&rct=j&q=%20quality%20of%20life%20in%20secondary%20schools%3A%20impact%20of%20internet%20and%20information%20technology%20on%20education&source=web&cd=1&cad=rja&sqi=2&ved=0CCAQFjAA&url=http%3A%2F%2Fwww.sapub.org%2Fglobal%2Fshowpaperpdf.aspx%3Fdoi%3D10.5923%2Fj.ijpbs.20120204.04&ei=PtxOUKmhHM_trQeYxYGQAQ&usg=AFQjCNFPWw-sg7w8MEe3eJ-VPExwSxd70A

Or: URL:
http://article.sapub.org/10.5923.j.ijpbs.20120204.04.html

7. AzizulHaq, Nakhat Nasreen and Alawi, Gamal Ahmed Ahmed Abdullah (2012). Integrated Learning Activities Based on Digital Library and Internet Technologies in Relation to their Usability and Satisfaction. *In Proceeding of IEEE Forth International Conference on Technology for Education*, pp. 188-191. IIIT Hyderabad, India. URL:

   http://ieeexplore.ieee.org/xpl/articleDetails.jsp?tp=&arnumber=6305967&contentType=Conference+Publications&queryText%3DIntegrated+Learning+Activities+Based+on+Digital+Library+and+Internet+Technologies+in+relation+to+their+Usability+and+Satisfaction

8. AzizulHaq, Nakhat Nasreen and Alawi, Gamal Ahmed Ahmed Abdullah (2012). Synchronous Online Teaching Based on Digital Library Technologies (Text, Audio, Video) in Relation to Effectiveness and Efficiency. *In Proceeding of IEEE Forth International Conference on Technology for Education*, pp. 249-250. IIIT Hyderabad, India. URL:

   http://ieeexplore.ieee.org/xpl/articleDetails.jsp?tp=&arnumber=6305921&contentType=Conference+Publications&queryText%3DSynchronous+Online+Teaching+based+on+Digital+Library+Technologies+.LB.Text%2C+Audio%2C+Video.RB.+in+relation+to+Effectiveness+and+Efficiency

9. AzizulHaq, Nakhat Nasreen and Alawi, Gamal Ahmed Ahmed Abdullah (2012). The Impact of ICT & Digital Library Techniques on Pre-service Teachers. *In Proceeding of National Seminar on Amalgamation of Information and Communication Technology: To levitate the quality of Teacher Education*, P.I. Institute of Information Management & Technology, Aligarh, India.

CHAPTER1

INTRODUCTION

The impacts of information technology have not left any aspect of life, including education. With the advancement of technology the entire pattern, style and pedagogy of education has changed. As a\result, research in education has found a new area to explore various aspects related to technology and education.

In this research work, the investigator has tried to explore the new techniques involved in Digital Libraries which are the part of information technology. This chapter will give the details of various concepts, terms, aims and objectives related to the topic in hand.

1.1) DIGITAL LIBRARIES – THE CONCEPT

The term "Digital Library" (DL) is used to refer to a range of systems, from digital library object and metadata repositories, reference-thinking systems, archives, and content management systems to complex systems that integrate advance digital library services and support for research and practice communities (Dagobert, 2008[31]). Dagobert[31] referred to a digital library as "it integrates access to materials with access to tool for processing materials (DL=materials+tools) and supports individual and community information aspects through functionality for selection, annotation, authoring/contribution, and collaboration".

IBM[63] defined a digital library as follows:

> "A machine readable representation of materials which might be found in a University library together with organizing information intended to help users find specific information. A digital library service is an assemblage of digital computing, storage, and communications machinery together with the software needed to produce, emulate, and extend the services provided by conventional libraries based on paper and other material means of collecting, storing, cataloging, finding, and disseminating information. A full service digital library must accomplish all essential services of traditional libraries and also exploit digital storage, searching, and communication".

Lesk (1997[86], cited by Malvia, R. N., 2008[116]) defined the digital libraries, as

> "DLs are organized collections of digital information. They combine the structuring and gathering of information, which libraries and archives have always done with the digital representation that computers have made possible. Digital information can be accessed rapidly around the world, copies for presentation without error, stored, compactly and searched very quickly, a true digital library also provides the principle governing what is included and how the collection is organized" (p.3).

The virtual library is known as digital library or e-library. Terence R. Smith (1997[136], cited by Malvia, R. N., 2008[116]) defined the digital libraries as:

> "controlled collection of information bearing objects (IBOs) that are in digital form and that may be organized accessed, evaluated and used by means of heterogeneous and extensible set of distributed services that are supported by digital technology" (pp.2-3).

Waters (1992[153], cited by Malvia, R. N., 2008[116]) digital libraries combine collection and expertise in a seamless interface. Therefore, it requires specialized staff to select, organize, evaluate, interpret, offer intellectual access, preserve the integrity and ensure the persistence over time of digital works so that they are readily and economically available for use by a defined community or set of communities.

D. Keye Gopen (1993[48], cited by Malvia, R. N., 2008[116]) defined the virtual library as:

> "A concept of remote access to networked world library and information sources. This is a synergy created by bringing together technologically the resources of many libraries and information services".

Oppenheim and Smithson (1999)[107] defined the digital library as:

> "An information service in which all the information resources are available in computer-process-able form and the functions of acquisition, storage, retrieval, access and display are carried out through the use of digital technologies" (p.97).

The Digital Library Federation provides a more comprehensive definition. It defines digital libraries as follows:

> "Organizations that provide the resources, including the specialized staff, to select, structure, offer intellectual access to, interpret, distribute,

preserve the integrity of, and ensure the persistence over time of collections of digital works so that they are readily and economically available for use by a defined community or set of communities" (Walters & Donald, 1998[150]).

Lynch et al. (1995)[92] 'digital libraries are systems providing users with coherent access to a very large, organized repository of information and knowledge' as defined by the Working Group of the US govt's Information Infrastructure Technology and Application (IITA). Berkeley (1994, cited in Larson, Ray R., 1994[83]) "Digital library is a global virtual library 'The Library' of thousands of networked electronic libraries".

Witten & Bainbridge (2002)[162] a digital library is an organized collection of information... a focused collection of digital objects, including text, video, and audio, along with methods for access and retrieval, and for selection, organization, and maintenance of the collection.

The history of digital libraries (DLs) is rich and varied because the concept of "digital library" is not new. Digital libraries, now a part of the global infrastructure, are being envisioned to interconnect many computer networks and versions of information technologies around the world, a partial fulfillment of a Bush's 1945 dream "Memex" of a personal micro-fiche-based system to tackle the problem of information overload.

The "library" metaphor is both empowering and constraining: (i) empowering, because digital libraries automate and extend opportunities offered by traditional libraries, as well as harnessing opportunities not possible on the Web; and (ii) constraining, because the metaphor evokes certain legacy impression, many originating in arbitrary physical constraints (Fox, E.A. et al., 1995[42]). Digital libraries represent a form of information technology in which social impact matters as much as technological advancement. Table (1.1.1): shows a major (Asian) digital library research and development milestones (Hsinchun et al., 2005[60]).

Table (1.1.1). Major (Asian) digital library research and development milestones (Hsinchun et al., 2005[60])

1994	NSF Digital Library Initiative Phase 1 (DLI-1) The First Annual Conference on the Theory and Practice of Digital Libraries, College Station, Texas
1995	First IEEE Advance in Digital Libraries Conference, McClean, Virginia
1996	First ACM Conference on Digital Libraries, Bethesda, Maryland
1997	First European Conference on Research and Advanced Technology for Digital Libraries (ECDL), Pisa, Italy
1998	The First International Conference on Asian Digital Libraries (ICADL, 1998), Hong Kong, China
1999	President's Information Technology Advisory Committee (PITAC) Report NSF Digital Library Initiative Phase 2 (DLI-2) Institute of Museum and Library Services (IMLS) Program NSF National Science, Mathematics, Engineering, and Technology Digital Library (NSDL) Program ICADL 1999, Taipei, Taiwan
2000	ICADL 2000, Seoul, Korea
2001	ICADL 2001, Bangalore, India First ACM/IEEE Joint Conference on Digital Libraries (JCDL 2001), Roanoke, Virginia
2002	ICADL 2002, Singapore
2003	ICADL 2003, Kuala Lumpur, Malaysia
2004	JCDL 2004, Tucson, Arizona

In 1994 the original digital library was initiated (DLI or DLI-1), sponsored by the NSF, DARPA, and NASA. The original program announcement stated, "The Initiative's focus is to dramatically advance the means to collect, store, and make it available for searching, retrieval, and processing via communication works – all in user-friendly ways. Digital libraries store materials in electronic format and manipulate large collections of those materials effectively. Research into digital libraries is research into network information systems, concentrating on how to develop the necessary infrastructure to mass manipulate the information on the Net. The key issues are how to search and display desired selections from and access large collections". The detail for DLI-1 and DLI-2 (1994-1998) programs in (http://www.dli2/nsf/gov/), from 1999 is to present many projects with undergraduate emphasis: (http://www.dli2/nsfs/gov/projects.html), (http://www.dli2/nsf/gov/itrprojects.html).

In addition to the core DLI-2 and related ITR projects, DLI-2 also sponsors 12 international digital library projects (http://www.dli2/nsf/gov/intl.html), involving partners from the UK (University of Liverpool, Southamptom University, King's College Landon), Germany (University Library of Gottingen, University of Trier), China (Tsinghua University, National Taiwan University), Japan (National Institute for Informatics), and Africa (West African Research Center). Several U.S. agencies also began to develop digital library projects that are uniquely tailored to their institution's function. For example, see (IMLS, http://www.imls.gov/about/index.html) for the Institute of Museum and Library Services, which is independent federal agency that fosters leadership, innovation, and lifetime learning. See (http://www.imls.gov/closer/cls_po.asp).

Another significant digital library research program was developing concurrently under the NSF National Science, Mathematics, Engineering, and Technology Digital Library Program (NSDL, http://www.nsdl.nsf.gov/indexx.html). More than 60 projects have been funded since 1998 in three areas: the collection track for offering contents (e.g., National Biology Digital Library; Digital Mathematics Library; Experimental Economics Digital Library); the service track for providing technologies and services (e.g., University of Arizona's Get smart e-learning concept map system);

and the core integration track for linking all contents and services under a unified framework.

Smith (1998)[131] described that digital libraries consisted of the collections of digitized resources as well as the links or pointers to other digital sources. Witten (2002)[161] called "digital library" as a collection-building tool. Renda & Straccia (2002)[121] presented a personalized collaborative digital library system where users could organize the information according to their own interests as well as exchange information with each other.

The social aspect of digital libraries emphasizes upon the activities people engage in when they create, seek, and use information resources. Research within this area focuses on user studies, usage log analysis, multicultural issues, and language-specific issues (Borgman, 1996[15]). Liew et al. (2000)[88] conducted an empirical evaluation to study the design of e-journals and how users interact with them. Adachi (2000)[1] presented NACSIS-ELS, a digital library system of Japanese academic journals. Zhao et al. (2002) developed a Chinese medical portal, CMedPort, which intedrates various techniques such as meta-search, cross-regional search, summarization and categorization.

In India until recently, Internet was accessible to a small group of academic and government users through the Education and Research Network (ERNET) and National Informatics Network (NICNET). Information and Library Network (INFLIBNET) was setup in 1993 by UGC to computerize and network the libraries of the universities and higher education institutes in India. Table (1.1.2) gives the details of information/library network systems in India as shown bellow:

Table (1.1.2). Information and Scientific Networks in India (S.I. Fazzuludin and Chikkamallaiah, 1996[123])

Networks	Network used by	Controlled by
NICNET	Government department and agencies	Planning Commission
ERNET	Institutions working in frontier areas of science and technology	Department of Electronics
CALIBNET	Libraries in Calcutta	Under the auspices of NISSAT
DELNET	Libraries in Delhi	Under the auspices of NISSAT
BOMNET	Libraries in Bombay	Under the auspices of NISSAT
MALIBNET	Libraries in Madras	Under the auspices of NISSAT
HYDLIBNET	Libraries in Hyderabad	Under the auspices of NISSAT
BALNET	Libraries in Bangalore	
BTISNET	Academic and research biotechnology institutions	Department of Science & Technology
INFLIBNET	University libraries and specialized R & D institutions	U.G.C.
DESINET	Defence science laboratories	Department of Defence
SIRNET	Laboratories under the C.S.I.R.	C.S.I.R.

Many projects have been carried out on digital libraries in different fields in the world; some of them have been presented below:

1-) A PROJECT ON INFORMATION DIGITAL VIDEO LIBRARY:

Located at Carnegie Mellon University; the objective of this project is to develop technologies for full-content search and retrieval from digital video libraries. The project team is creating a test bed to enable K-12 (10+2 level in India) students to access, explore and retrieve science and mathematics materials from the digital video library by combining speech, image and natural language capabilities. It will initially contain 1,000 hours of video. See (http://fuzine.mt.cs.cmu.edu/im/informedia.html).

2-) ILLINOIS DIGITAL LIBRARY PROJECT:

This is located at University of Illinois, Urbana Champaign (http://www.grainger.uiuc.edu//dli). Focus here is on providing comprehensive search and display of complete contents of articles, indexing text, figures, equations and tables to articles from engineering and science journals, obtained in SGML format directly from the major partners in publishing industry.

3-) ALEXANDRIA DIGITAL LIBRARY PROJECT:

Located at University of California, Santa Barbara (http://alexandria.sdc.ucsb.edu/), the goal of this project is to provide access to collections of variety of special information, including digitized maps, images, air photos, and other graphical information, relating to the counties of Santa Barbara, Ventura and Los Angeles in California State. The range of the users includes school children, academic researchers and the general public.

4-) UNIVERSITY OF MICHIGAN DIGITAL LIBRARY PROJECT (UMDL):

This project focuses on earth and space sciences (http://sils.umich.edu/UMDL/Homepage.html).

5-) UNIVERSITY OF BERKELEY DIGITAL LIBRARY PROJECT:

The goal of this project is to develop technologies for intelligent access to massive collections of multi-media documents including satellite images, video, full text documents, comprising of multiple terra byte databases (http://http.cs.berkeley.edu/~wilensky).

6-) THE STANFORD DIGITAL LIBRARY PROJECT:

The technology developed in this project will provide the "glue" that will make this worldwide collection usable and unified entity, in a scalable and economically feasible fashion (http://www.diglib.stanford.edu/diglib).

7-) UNIVERSITY OF CALIFORNIA CD-ROM INFORMATION SYSTEM:
This system provides online access to a CD-ROM based database, through the Web, consisting of published federal (U.S. govt.) statistics covering 1990 census and foreign trade data, equivalent of about 260,000 books (http://cedr.lbl.gov/cdrom/doc/cdrom.html).

8-) CORE PROJECT:

This project covers five years of 20 primary journals published by the American Chemical Society, consisting of about 425,000 pages. The data is mentioned in two forms scanned images stored on Sony WORH jukeboxes and as SGML marked up ASCII files, for each page, stored on a SUN UNIX file server.

9-) BRITISH LIBRARY'S INITIATIVE FOR ACCESS:

This is a program of 20 development projects, initiated in 1993, to investigate hardware and software platforms for the digitization and subsequent networking of a range of library materials.

The framework summarizes what are important issues in digital library research and close relation between academic, practitioner, user and policy – making communities. "We should provide a valuable tool for understanding the nature of digital libraries and for comparing and analyzing the results of research and experience of practice," as stated by Ian Rowlands and David Bawden (1999)[62]. See Figure (1.1.1) for understanding the digital library.

To understand the interaction between the digital libraries and society, some examples have been presented as follows: Humanity Development Library, a collection of some 1,200 authoritative books and periodicals, produced by many disparate organizations on various areas of human development, from agricultural practices to economic policies, from water and sanitation to society and culture, from education to manufacturing, from disaster mitigation to micro-enterprises. It contains 160,000 pages and 30,000 images, and occupies a small library book stack. It produced using the Greenstone software, and freely distributed open source project. Collection built with Greenstone offers simple but effective searching and browsing facilities based on metadata and full text of electronic documents. However, the collection maintainer may choose to present the original source document (whether Word, PDF, PostScript, PowerPoint, Excel, a QuickTime movie, an audio file or whatever) (Witten, 2002[161]).

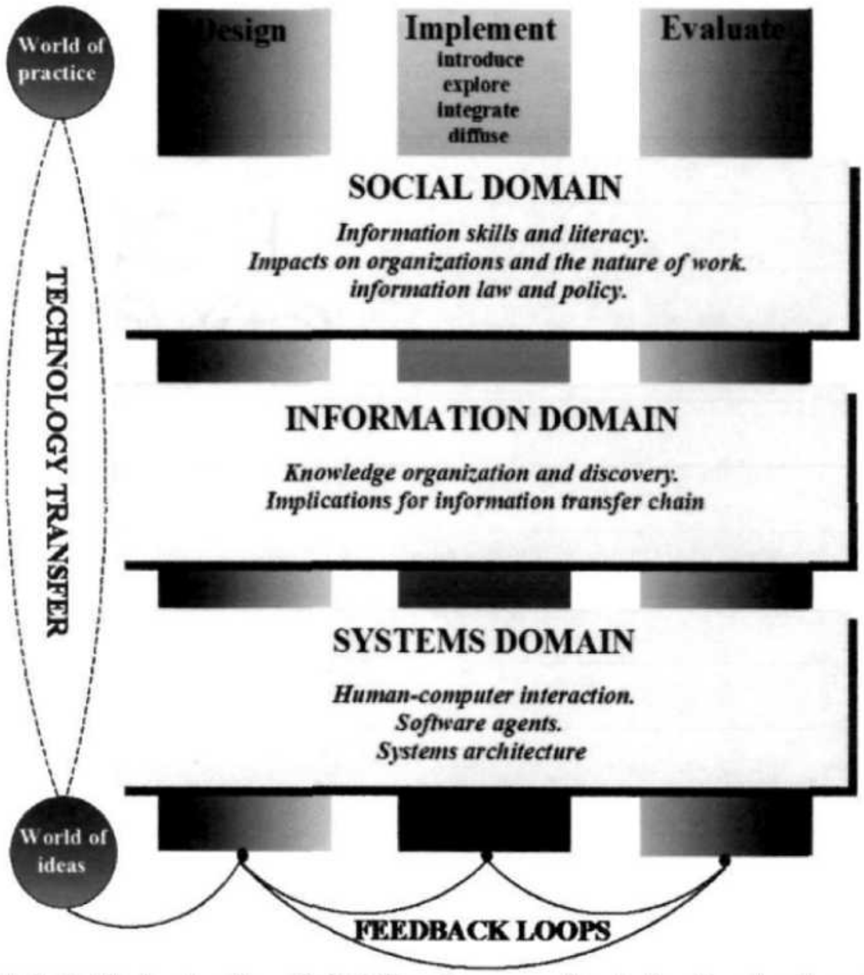

Figure (1.1.1). Understanding digital libraries according to Ian Rowlands and David Bawden (1999)[62]

The Researching Education Development Library is a project of the Department for International Development (DFID). It has a CD-ROM library containing many education research papers and other documents. The UNAIDS Library contains publications in the "Best Practice" collection (including key materials, case studies, technical updates, and points of view). The Health Library for Disasters is the result of collaboration between the emergency and disaster programs of the World Health Organization (WHO) and Pan American Health Organization (PAHO). It contains more than 300 technical and scientific documents on disaster reduction and public health issues related to emergencies and humanitarian assistance (Witten et al. 2002[163]). Ismail Fahmi

(2003)[65] described various technical and social issues in the development of the Indonesia's National Digital Library Network (Indonesia DLN). The success of the network was attributed to the use of the Protocol for Metadata Posting (PMP) to allow member institutions without a permanent Internet connection to join the digital library (DL) network. In addition to the use and distribution of open source software, and the application of the network of networks concept that motivated and permitted communities to develop their own DL networks that are integrated to the Indonesia DLN. It is interesting to note that the sustainability of the network is mainly due to the distribution of the code as open source (Purbo, 2004[114]). Byrne (2003[19]) identified the following factors contributing to the complexity of dealing with digital resources:

- Volume and Selection of Electronic Resources.
- Intellectual Property Considerations.
- Absence of or incomplete bibliographic details.
- To catalog or not to catalog.
- Evolving standards.
- Vanishing URL.
- To download or retain the Virtual format.
- Licensing and Costs.
- IT infrastructure and levels of access.
- Number of staff and Expertise.

Digital libraries are currently envisioned to become effective repositories of global knowledge resources, encompassing "all aspects of human activities, from industries to governments, and from education to research" (Chen, 2003a[23], p.1). The current of digital portals results in dramatic increase in usage of databases and other electronic information sources (Hamblin & Stubbings, 2003[54]). For instance:

1. The National Science Digital Library (NSDL) (2007) uses visualization software to group and relate concepts, but also offers a text-based interface to enable browsing. For example, individuals can search the NSDL using a specific term such as "Education Technology" and then click on different subcategories of resources on education technology in order to retrieve links to the resources.

2. The Alexandria Digital Library permits geospatial learning as well as longitudinal/ latitudinal and temporal periods of organization. For example, individuals can click on "California" then "San Diego" and choose different maps, air photos and satellite images of the area from 1950 to the present.

These two have the following in common:

a. Each digital library provides nonlinear access to the resources, contains contextual information in the form of textual and visual cues that guide information seeking,

b. demonstrates the relationships amongst resources and functions as self-contained information space by providing immediate access to its materials,

c. Though the formats vary (e.g., mp3, MS Word, Adobe Acrobat), the resources themselves, including images, audio, and motion picture, can be accessed on line.

Digital libraries (Fox E. A., et al., 1995[42]; Levy & Marshall, 1995[87]) have been developed to efficiently organize, store, and provide access to the rapidly increasing amount of digital information. Arms et al. (1997)[6] reported an experimental system developed by the National Digital Library Project (NDLP) at the Library of Congress. The work described how technical building blocks were used to organize collection of materials and word, PowerPoint, and LaTex, a Supervised learning based method. Hu et al., (2005[61]) have proposed to identify title of the document using formatting and font features embedded within the document. A digital library for computer and information science, also automatically extracts Dublin Core metadata Cite Seer (Giles, Bollacker, & Lawrence, 1998[47]). At the end of this section the researcher enlists the number of volumes held by major US and global libraries from 1910 or earlier to 2002 that are a brief of digital library history as shown in both the tables (1.1.3) and table (1.1.4) respectively (Michael Lesk, 2005[98]).

Table (1.1.3). Number of volumes held by major US libraries (Michael Lesk, 2005[98])

Volumes Held			
Institution	1910	1995	2002
Library of Congress	1.8M	23.0M	26.0M
Harvard	0.8M	12.9M	14.9M
Yale	.55M	9.5M	10.9M
U. Illinois (Urbana)	.1M	8.5M	9.9M
U. California (Berkeley)	.24M	8.1M	9.4M
New York Public Library	1.4M	7.0M	11.5M
U. Michigan	.25M	6.7M	7.6M
Boston Public Library	1.0M	6.5M	7.5M

Table (1.1.4). Number of volumes held by major global libraries (Michael Lesk, 2005[98])

Number of volumes Held					
Institution	Earlier	1910	1996	2002	Former name, if any
British Library	240 k (1837)	2M	15M	18M	British Museum Library
Cambridge Univ.	330 (1473)	500K	3.5M	7M	N/A
Bodleian (Oxford)	2 k (1602)	800K	4.8M	6M	N/A
Bibliotheque Nationale de France	250 k (1800)	3M	11M	12M	Bibliotheque Nationale
National Diet Library	N/A	500K	4.1M	8M	Imperial Cabinet Library
Biblioteca Alexandrina	533 k (48BC)			240 K	Library of Alexandrina

1.2) IMPORTANT FEATURES AND ADVANTAGES OF DL

UNECA (2003)[143] has described different features for digital libraries such as:

1. Digital libraries are organizations with specific objectives or goals. Most digital library project's objective is to generate, collect, store, and organize information in digital form, and make it available to defined groups of users for searching, retrieval, and processing via communication networks.

2. Digital libraries have functions and processes being undertaken in order to achieve the objectives and goals of the organization. These include selecting resources to be included in the collection; offering access to resources; distributing the resources, etc. These functions and processes are carried out by a combination of human resources and technological resources.

3. Digital libraries are made up digital collections. Digital libraries store materials in electronic surrogates like bibliographic records (metadata) and indexes in addition to full-text documents, audio files, and images some of which cannot be represented or distributed in printed form. These digital works include both internal and external resources.

4. Digital libraries serve a defined community or set of communities. Digital libraries are set-up to serve users, and the information needs of the target community or set of communities determine the information content and services of the digital library.

5. Users through a single user-friendly interface access digital libraries. The main purpose of the user interface is to perform as an 'access and integration layer' to a managed environment of quality assured information sources in local and distributed environments, which are available from many sources (Thomas, 2000[139]).

The salient features of a digital library according to T. B. Rajasheker (1996)[135] are as follows:

1. It is unique referencing of digital objects.
2. Enable 'link' representation to local/external objects (hypertext).
3. Clearly separates the digital library and the user interface by employing client-server architecture.
4. Supports advanced search and retrieval.
5. Available for a very long time (i.e., should not be dependent on specific hardware and software).
6. Supports traditional library missions of collection, development, organization, access and preservation.
7. Integrate personal, group, enterprise, public digital libraries.
8. Supports publishing, annotation, and integration of new information.

The worth mentioning features of the digital library according to Rama Nand Malviya (2008)[115] are as follow:

1. Documents of a digital library are available in digital format. Therefore, any digitization project has to perform several activities such as

assessment and selection of originals, grant applications and fun rising, feasibility testing, costing and piloting, copyright clearance and rights management, benchmarking, quality assessment, metadata design and creation, delivery and long-term preservation.

2. Since the digital library facilitates immediate access to high-demand and frequently used items, its ultimate success depends on the advanced digital technologies. In other words, the present day librarianship deals both digital as well as non-digital information and both types of information is handled by using Information Communication Technologies.

3. Digital libraries are to be used by individuals wnrking alone. Hence, professionals should have undergone an orientation cum training to enhance their skills to perform better work to render effective services in the digital environment.

4. Digital library is capable of meeting the challenges of the Global resource-sharing phenomenon as it is of transferring data within and outside the countries breaking the physical boundaries of data.

Rama Nand Malviya, (2008)[115] described the advantages of digital libraries as a means of easily and rapidly accessing books, archives and images of various types are widely recognized by commercial interest and public bodies. Rama also discussed the advantages of digital libraries as follows:

1. The user of a digital library needs not to go to the library physically; people from all over the world can gain access to the same information as long as an inherent connection is available.

2. A major advantage of digital libraries is that people can gain access to the information at any time, night or day.

3. A number of users can use the same resources at the same time.

4. Digital libraries provide access to much richer content in a more structured manner.

5. The user is able to use any search terms (word, phrase, title, name, and subject) to search entire collection. Digital libraries can provide very user-friendly interface, giving clickable access to its resources.

6. An exact copy of the original can be made any number of times without any degradation of quality.

7. Whereas traditional libraries are limited by storage apace, digital libraries have the potential to store much more information, simple because digital information requires very little physical space to contain them. When a library has no space for extension digitization is the only solution.

8. Particular digital library can provide a link to any other resources of other digital libraries very easily, thus a seamlessly integrated resource sharing can be achieved.

9. The cost of maintaining a digital library is lower than that of a traditional library.

UNECA (2003)[143] introduced the benefits of the digital libraries as follow: The major advantages of digital libraries over traditional (paper-based) libraries including faster additional to the data collection with better quality control, improved search functionality and faster access to information found, but also more freedom and reduced bureaucracy for individual users (IBM, 1994[63]). In addition to those, there are other potential benefits of digital libraries. These include the following:

1. A digital library is available wherever there is a personal computer connected to the network. Therefore, it can be accessed at work places and in the home.

2. Digital libraries' information resources are available for access to users around the clock.

3. In a digital library environment, it is possible and easier to provide access to information resources in other formats that are not possible in the print format environment, i.e., multimedia formats like video and audio.

UNECA (2003)[143] discussed the infrastructure requirements for digital libraries. The following are some of the human, financial and technological infrastructure issues that should be taken into account while considering a digital library:

1. Availability of appropriate information and communication infrastructure on which the digital library will be built. This will include appropriate hardware, software, and adequate network connectivity.
2. Availability of human resources with appropriate skills. Skills requirements largely depend on the nature and sophistication of the digital library being implemented and may include: hardware specialists, network administrators, database administrators, programmers, content developers, information manager (librarian) etc.
3. The target community of users should have access to the necessary hardware, software, and network connectivity. In addition, users should

have appropriate information skills relevant to the digital environment. They should be able to access and manipulate information in various digital formats – text, video, audio, and database.

4. Availability of financial resources that support and sustain the development of the digital library since hardware, software, and manpower cost money, and so is the maintenance of the technological infrastructure, licensing of access to external resources payment for copyright, etc.
5. Availability of appropriate legal and technical safeguards to guarantee authenticity and integrity of information and protect privacy, and abuse of intellectual property rights and copyright, where are appropriate. In fact, digital libraries raise more different and complex copyright issues than traditional libraries.
6. Availability of standards, which are managed the digital information resources. For good quality information resources, databases, and effectiveness of information searching and retrieval, electronic information management standards should be employed. Standards such as metadata standard, object data construction, data navigation standard are required.

There has been a progressive trend in recent years towards individualized instruction (Geddes and Sturtridge 1982[46]; Altman and James 1980[4]), and with this has come a desire to give the learner greater responsibility for his own learning.

Nowadays, using technology in education and training is not a new process. Traditional technologies such as flip charts, audiocassettes, and even printed materials have been used since their discoveries (Jonassen, 1996[69]). Therefore, the learning styles are important to diagnose the learning input to manipulate its using with some processes to gain the better output. Hence, the most frequently quoted definition of learning styles is Keefe's (1979a)[76]:

> "Learning styles are characteristic cognitive, affective, and physiological behaviors that serve as relatively stable indications of how learners receive, interact with, and respond to the learning environment; the learning style is considered as a fixed pattern responding to the environment" (p. 4).

This definition included both internal and external traits to determine individual learning preference and definition was widely accepted. Keefe (1987)[75] stated that the framework of learning styles consists of three dimensions: (a) the cognitive dimension, which is concerned with perception and analysis of data; (b) the affective dimension, which deals with personality elements; and (c) the physiological dimension, which encompasses human body by variables. Dunn (1983[36], 1984[37]) and Reinert (1976)[120] identified four basic learners' perceptual learning modalities: (a) Visual learning: reading studying charts; (b) Auditory learning: listening to lectures audiotapes; (c) Kinesthetic learning: experiential learning, that is, total physical environment in which learning happens; and (d) Tactile learning: "hands-on" learning such as building models or doing laboratory experiments. Warschauer (1995)[151] pointed out that (a) repeated exposure to the same material is beneficial or even essential to learning; (b) a computer is ideal for carrying out repeated drills because the machine does not get bored presenting the same material and because it can provide immediate nonjudgmental feedback; and (c) a computer can present such material on an individualized basing, allowing students to proceed at their own pace, freeing up class time for other activities. In Taiwan, most the educational software was designed by PLATO in order to train students effectively and help students get the higher scores in a short time to pass the difficult exams (Joe & You, 2001[68]; H. C. Liu, 2001[90]; M. Y. Liu & Chen, 2004[91]). To this end the multimedia-networked computer provides a range of informational, communicative, and publishing tools that are potentially available to every student (Barnes, 2000[8]; Carico & Logan, 2004[20]; Hazari, 2004[56]; Im & Lee, 2004[64]; McAlister, Ravenscroft, & Scanlon, 2004[93]; Schultz, 2003[128]).

Generally, the Internet includes many different features for communicating and exchanging information. Many scholars (Chapelle, 2001[22]; Dueme et al, 2002[35]; McDonald, 2002[94]; Morgan & Beaumont, 2003[99]; Warschauer, 1998[152]) noted "three main features of the Internet that can be categorized as (a) asynchronous computer-mediated communication, (b) synchronous computer-mediated communication, and (c) hypertext" (pp. 13). Specially, the best example of hypertext, the third feature of the Internet, is the World Wide Web, which is actually a nonlinear, linked, or layered from of information organization whereby documents in a database are connected via hyperlinks (S. C. Chen, 1996[24]; Chiu, 1997[27]; Frizler, 1995[43]; Groeling, 1999[53]; K. W. Lee, 2000[85]; Pilkington & Bennett, 2000[110]; Salmon, 2000[125]). Students can use the World Wide Web to access multimedia documents with clickable links to other documents and look for any kind of information by using a search engine (Graham & Scarborough, 1999[49]; Warschauer, 1995[151]). In particular, the World Wide Web (WWW), incorporating multimedia, hypermedia, and other valuable resources, have helped teachers generate more alternative learning instruction and enhance learning activities. In order to integrate the WWW into writing instruction, writing teachers should be mindful of the function and limitation of web-based instruction (Barnes, 2000[8]; Carico & Logan, 2004[20]; Hazari, 2004[56]; Im & Lee, 2004[64]; McAlister et al., 2004[93]).

Like the hyperlink on the Internet, the connection among all participants in collaborative learning brings about active learning in a class (S. C. Chen, 1996[24]; Chiu, 1997[27]; Frizler, 1995[43]; Groeling, 1999[53]; K. W. Lee, 2000[85]; Pilkington & Bennett, 2000[110]; Salmon, 2000[125]). Collaborative learning occurs when learners work in groups on the same task at the same time, thinking over issues together and dealing with complexities. Interaction in a collaborative class can occur among all the participants: the students, instructors, parents, administrators, and even the researchers (Panitz, 1999[108]; Poole, 2000[112]; Salmon, 2000[125]; Walker, 2004)[146]. To state it differently, students can learn to participate both directly and peripherally in activities within a community in the target learning with a view to becoming fully literate (Barnes, 2000[8]; Green, 1998; Horton, 2001[59]; Jonassen, 1996[69]; Knowlton, 2001[81]; Morgan & Beaumont, 2003[99]). Collaborative learning or group learning is a learner-centered model that treats the learner as an active participant who constructs knowledge from a wide range of experience, information sources, and interaction with the others. Overall, interaction helps students develop communication skills, promotes reflective thought, and enhances in-depth learning (Groeling, 1999[53]; Ho & Swan, 2007[58]; Jonassen, 1996[69]; Kling & Courtright, 2003[80]; Lapadat, 2002[82]; McDonald, 2002[94]). Formulating ideas in their own words and receiving feedback and evaluation from their peers, students learn to construct their own knowledge, thinking skills, and meanings socially (Barnes, 2000[8]; Carico & Logan, 2004[20]; Harasim, Hiltz, Teles & Turoff, 1995[55]; Hazari, 2004[56]; Im & Lee, 2004[64]; McAlister et al., 2004[93]).

The operation of the Internet and the development of the WWW in computer-based instruction in recent years have provided teachers and students with alternative ways of communication (S. C. Chen, 1996[24]; Chiu, 1997[27]; Frizler, 1995[43]; Groeling, 1999[53]; K. W. Lee, 2000[85]; Pilkington & Bennett, 2000[110]; Salmon, 2000[125]). The WWW has created an environment where meaningful learning is fostered and supported. In addition, many scholars (Barnes, 2000[8]; Carico & Logan, 2004[20]; Joe & You, 2001[68]; McDonald, 2002[94]; Poole, 2000[112]; Walker, 2004[146]) indicated that web-based hypermedia instruction (WBI) applies the attributes of the resources of the WWW. Properly structured, WBI can help learners engage in a series of instructional activities that present information, offer practice, and provide feedback to inform learners of their strengths and weaknesses as well as suggestions for learning enrichment or remediation (Bruce et al., 1993[17]; Green, 1998[50]; Kemp, 1993[78]; Lapadat, 2002[82]; Walker, 2004[146]). While students play active and autonomous roles in learning in WBI, teachers may play a role of facilitator, guide, counselor, and information provider (Bickel & Truscello, 1996[11]; Bruce et al., 1993[17]; Green, 1998[50]; Kemp, 1993[78]; Lapadat, 2002[82]; McDonald, 2002[94]; Pilkington & Bennett, 2000[110]; Schultz, 2003[128]; Walker, 2004[146]). Through WBI the students select the learning materials: text, images, and video clips with subtitles. Wallace & Mutooni, (1999[147]) found that the students in WBI actually showed more positive interest in learning than those in the regular class. Because WBI is more student-centered learning instead of instructor-centered learning, students learn materials interactively from themselves, peers, and Internet in addition to their instructors. Agarwal and Day (1998)[2] also conducted a comparative study on WBI. The participants in their study used information they located on the WWW to complete Web projects. Results indicate that the Web had a positive influence on these students' learning (Y. C. Cheng, 1999[26]; Garrison, 2003[45]; Ho & Swan, 2007[58]; Kling & Courtright, 2003[80]; Lapadat, 2002[82]).

1.3) THE IMPACT OF TECHNOLOGY ON EDUCATION AND LEARNING

The effective use of technology has been shown to maintain learner's interest for long periods, increase retention, offer distance education possibilities, and provide more opportunities for learner (self) directed learning (Jonassen, 1996[69]; Lim-Youngsook, 1996[89]; McDonald, 1996[95]; Young-Shwu-Ching, 1996[166]). McDonald (1996)[95] studied the impact of multimedia instruction upon students' achievement and attitudes. His findings showed that the use of multimedia technology had a positive effect upon student attitude and achievement. As technology continues to become more widely available, and as it is less expensive and easier to use, technology will likely change the methods for delivering instruction (Florini, 1989[41]; Sliwa, 1994[130]; Wilson, 1991[160]). Technology has the potential to support curriculum and policy reform. However, reform efforts alone will not cause the necessary change. There is a reciprocal relation between reform and technology. As Means (1994)[96] argued, technology drives reform in education, but also "education reform makes a school ripe for technology" (p. xii).

1.4) DIGITAL LIBRARIES AND ONLINE RESOURCES OF EDUCATION

There are studies that supported the creation and organization of online resources for classroom use (Dorward, Reinke, Recker, 2002[34]; Means & Olson, 1997[97]; Recker, Dorward, & Nelson, 2004[119]; Summer & Dawe, 2001). This includes the creation of online resources, repositories (digital libraries) to store online resources, and tools to implement the usage of the resources in the classroom. The National Science Digital Library (http://nsdl.org) is an example of such an educational digital library. The NSF-sponsored NSDL provides access to a comprehensive collection of science, technology, engineering and math (STEM) resources targeting all educational levels-prekindergarten through Grade 12, undergraduate, and life-long learners (Zia, 2001[168]). The NSDL describes itself as

> "A digital library of exemplary resource collection and services, organized in support of science education at all levels. Starting with a partnership of NSDL funded projects, NSDL is emerging as a center of innovation in digital libraries as applied to education, and a community center for groups focused on digital library enabled science education" (National Science Digital Library, 2002[169]).

Other examples include the Australian Learning Federation (http://www.thelearningfederation.edu.au), the European Union's Foundation (http://www.ariadne-eu.org), EduSource Canada (http://www.edusource.ca), and the California Berkeley Digital Library (http://www.berkeley.edu/). Key objectives of these initiatives are to improve teacher and learner access to high-quality learning resources and to increase their use in order to improve education (Recker et al., 2005a[117]; Wattenberg, 1998[154]; Zia, 2001[168]). Teachers have access to innovative curricula and can customize students' learning by introducing new materials and resources, ultimately improving students' educational experiences. Rather than relying on outdated textbooks, teachers can find the most current information and resources and implement these in their classroom in a variety of ways (Wallace, Soloway & Krajcik, 1998[149]). Furthermore, the instructional technology researchers have turned to online resources as a way to help increase teacher efficiency, improve student learning, and lower development costs (Sumner & Dawa, 2001[134]). The widespread availability of online resources on the Internet is perhaps the most valuable technology available to teachers and students (Becker & Ravitz, 2001[9]).

1.5) THE PROBLEM AND RESEARCH QUESTIONS

Evaluation of digital libraries is essential component for the design of effective digital libraries. Digital libraries are designed for users to use. Users connect through a human-computer interface and interact with the digital library; though in some cases the digital library may be an embedded system that is seen only indirectly, however, most commonly, a digital library has an interface for users to search, browse, follow links, retrieve, and read documents. As can be seen in Figure (1.5.1), that interface may be specialized according to what roles the user plays. However, most of the researches on evaluation of digital libraries have applied criteria from researchers themselves. In particular, these studies focused on the usability studies and some focused on evaluation criteria from users' perspectives. Furthermore, users treat the library system as a tool, not as an object of the study. However, researches are available on usability of digital libraries and active learning in digital libraries separately but such a study, which establishes a relationship between learning assessment and usability of digital libraries, is not available in Yemen country or abroad. Therefore, a study of such nature was felt. In this study, users (academic users or learners) treat the library system as a tool and an object of the study in the area of Human-Computer Interaction (HCI), Field of Education, and Personalized Information Environment (PIE). This study concentrates on digital library as a technique to enhance learning from users' perspectives.

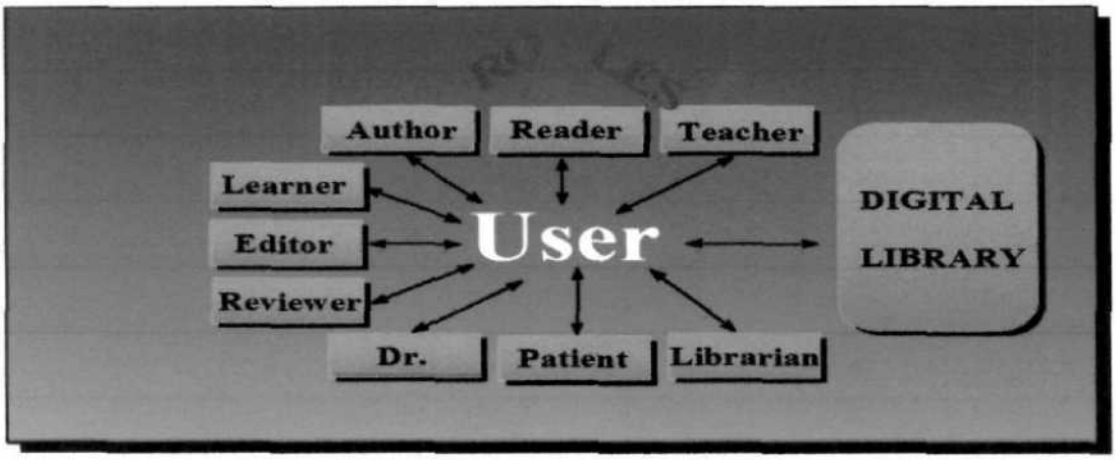

Figure (1.5.1). User Direct according to Edward A. Fox (1999)[38]

The research questions examined in this research are as follows

RQ1: Do the effectiveness and efficiency of using the digital library materials have influences on students' satisfaction?

RQ2: Does the efficiency of using the digital library materials have influences on students' satisfaction?

RQ3: Does the effectiveness of using the digital library materials have influences on students' satisfaction?

RQ4: What are the influences of learning activities and usability on the ease of use of the digital library?

RQ5: What are the differences between students' experience and using Internet?

RQ6: What are the influences of the digital library learnability on the ease of learn?

RQ7: What are the influences of the time spent for using the digital library on students' satisfaction?

RQ8: Can the number of steps of using the digital library materials lead to the full students' satisfaction?

RQ9: What are the influences of learning activities on students' satisfaction?

RQ10: What are the influences of learning activities on learnability of the digital library?

RQ11: Do the students' activities have influences on active learning?

RQ12: Does the usability have influences on the levels of time spent?

RQ13: Does the usability have influences on the levels of steps?

RQ14: Does the usability have influences on the levels of satisfaction?

RQ15: Does the usability have influences on the levels of learnability?

RQ16: Does the active learning have influences on the levels of information seeking?

RQ17: Does the active learning have influences on the levels of active consuming?

RQ18: Do the learning activities and usability have influences on students' learning?

RQ19: Do the learning activities and usability have influences on students' activities?

RQ20: Do the learning activities and students' activities have impacts on the digital library usability?

RQ21: Do the learning activities and usability have impacts upon students' active learning?

1.6) SIGNIFICANCE OF THE STUDY

The present researcher is interested to work in this field because Digital Library Techniques give a new dimension to education technology, are beneficial for the masses, economical by nature, and have very vast coverage area. In the past, the education depended on the traditional library that has physical places to search the information, reading in the specific places or borrow some books, references, journals, etc. At the same time, problems/queries of students remained unexplained for long time, so the students needed much time to solve those queries and get the answers, but as the time has changed now, with the invention of digital libraries it is possible to solve the queries of the students immediately and simultaneously. However, while using digital libraries techniques they are facing challenges like weak server, problem of access, lack of technical knowledge.

Through this humble attempt, the researcher wants to find out the learning activities of the learner while using digital libraries materials and his level of usability is helping to achieve his learning goals. The importance of digital libraries in the field of education cannot be overlooked. The digital library promotes learning through personal ownership and management of the learning process while connecting the learner with the content and communities of learners and educators. Dong and Agogino (2001)[5] referred to that:

> "Content and services provided through the digital library will generally include multimedia courseware, digital problem sets and exercises, educational software applications, related articles and journals, and instructional technology services for educators and students, both commercial and non-commercial – all organized and labeled for the purpose of education and instruction… The tasks of the digital library are to find the learning resources, supply useful tips on applying them to current learning goals, and surface information that would aid in the decision to incorporate the learning elements" (p. 2).

Unfortunately, education species are disappearing today at a faster rate than scientists who are able to use traditional means of collecting and sharing information. The use of information and communication technologies to support learning activities (a field now known as education technology) has fostered the educational digital libraries (EDL). So the digital library can be one of the important means used in the educational field especially in the distance learning when the teachers are absent from the classroom and the education processes, and the students need to get information to do their activities in different area of education and improve their levels of learning by using different materials. Moreover, these materials open new channels for students in educational procedures. Tanyss Munro and Ian Pringle[100] indicated to that:

> "Distance education materials tend to have been text-based where print materials are exchanged between learner and instructor/tutor by post, courier or through local distance learning centers. Much use is also made of email, chat rooms and other computer-based tools to support learners. Both synchronous and asynchronous exchanges and discussions may take place to support learning, the latter often within set limits of time (a week or two), allowing learners to contribute when it suits them given their other commitments. Discussions among learners and between learner and tutor are easily managed through email, as are links to libraries and databases. Using text-based materials still presents a barrier for learners with limited experience with formal education and with limited literacy skills, however, and audio and visual media can help to overcome this."

Dr. A. P. J. Abdul Kalam (cited in Rama Nand Malviya, 2008[115]) described the role of digital library, as it is where the past meets the present and creates a future. A digital library provides equitable access to knowledge to all people, irrespective of place, caste, creed, color or economic status. Digital library unites rather than divides. Therefore, there is a need to develop digital libraries, and generate user friendly techniques in this area. Unless the difficulties faced by the learners are searched, how can new technologies be developed that solve their problems?

Digital Libraries are not available in Yemen Country at all because higher education is established only in 1970 under Sana'a University and Aden University, which are the first two Universities in Yemen Country. The total of government universities are nine (10) only [Al-Eman, Alahgaff, Dhamar (Thamar), Hadramout, Hodeidah, Ibb, Sana'a, Taiz, Aden, and Al-Baitha], three (3) private universities [Nation University, Science and Technology University (UST), and Saba University] and some centers such as American Institute for Yemeni Studies, Andalus University For Science and Technology, Center for Arab Language and Eastern Studies, Sana'a (CALES), Duke Islamic Studies Center, French Center for Archeology and Social Sciences in Sanaa, Ministry of Agriculture and Irrigation National Council on U.S. - Arab Relations, Queen Arwa University (QAU), Sana'a Institute for Arabic Language, Sheba Center for Strategic Studies (SCSS), The Middle East and Middle Eastern American Center (MEMEAC) at the Graduate Center at CUNY lists the YCMES as a study abroad program, University of Science and Technology Hospital, Water and Environment Centre (WEC), Yemen American Language Institute, Yemen College of Middle Eastern Studies, Yemen Language Center, Yemen Ministry of Public Health. The Republic of Yemen has been making consistent efforts to bring its entire people into the educational mainstream. Then only Yemen can be in the forefront of academic development on the global platform. In fact, Yemeni government has successfully outlined a definitive strategy with quite clearly laid out plans about improvement of education in Yemen. President Ali Abdullah Saleh has set four priorities for the government. They are: 1) improving living conditions, 2) fighting corruption, 3) reducing poverty, and 4) encouraging foreign investments and globalization. Achievement of these objectives is not possible without streamlining the educational system. However, the educational scenario in Yemen is beset with many problems that strike at the root of the effective implementation of the policies of the government. It is an admitted fact that after the dark age of Imam Yahya, education in Yemen has witnessed an impressive era of expansion. Nevertheless, the quality has suffered to a remarkable extent for the sake of making education accessible to the majority. Yemen shares most of the problems of the third world countries. Some of these are large classes, poor infrastructure, and low level of the learners' proficiency, mixed abilities classes, poor teacher competence and lack of qualified teachers. In order to combat with the given situation of education, Yemen imported teachers along with courses from abroad. They are involved in the task of preparing curriculum, teachers and textbooks. However, all these acts of advancement are stalled due to some gaps and lapses. The literacy rate in Yemen is low and the women's literacy rate is still lower. Many of the children are out of school and the dropout rate is still very high. All those who pass out are found to be lacking even in the minimum level of proficiency. There is an "absence of participation expected from the society and the pioneering productive organizations in the decision making councils" (Educational Indicators of the Republic of

Yemen, 2005, -6:43, cited by Rama Kanta Sohu, 2008[124]). In order to enhance learning outcomes, Yemen establishes the first digital collection of information called National Information Center as first step to construct first digital library in Yemen as shown in Figure (1.6.1) below:

Figure (1.6.1). National Information Center according to http://www.yemen.nic.info

This national information center can not provide education materials such as video, audio, animation, graphics, journals, periodicals, articles, etc. because, it is the collection of documents for theses and dissertations and social resources of information such as tourism etc. So the study of digital library, along with its problems and solutions becomes so important to support the higher education in Yemen that the researcher could not resist to take this work in his hands.

No doubt, the scope of research in Digital libraries is very wide. New areas are emerging day by day. Mostly the people from Engineering and Technology are contributing a lot in this field of knowledge; nevertheless researchers in Educational technology and distance learning have also shown tremendous exploration.

Learner's satisfaction is a very important factor in enhancing the knowledge through Digital Libraries. Being inspired by such studies the researcher wanted to explore and assess various types of techniques of digital libraries with special reference to their usability & effectiveness and to find out their relationship with learners' efficiency, satisfaction & learnability.

1.7) STATEMENT OF THE PROBLEM

The problem is formally stated as below:

"Learning assessment of digital library techniques: usability, effectiveness, efficiency, satisfaction, and learnability".

1.8) OBJECTIVES OF THE STUDY

The main objective of this research is to assess the major techniques of digital libraries with special reference to their usability, and effectiveness in relation to the learners' efficiency, satisfaction & learnability.

The main variables in this study are usability and effectiveness with reference to digital library and efficiency, satisfaction and learnability with reference to learner.

The specific objectives include:

1 To explore various techniques of learning via digital library;

2 To evaluate these techniques of digital library;

3 To discuss the impact of these techniques on learner's efficiency, satisfaction & learnability; and

4 To highlight the need for education by using digital library techniques as virtual means

1.9) DELIMITATIONS

As Yemen is a large country, it is difficult to cover the entire geographical area in a single study like the proposed one; therefore, the researcher selected the sample from the higher education institutions only, (English Language Teaching, Undergraduate final year students of Taiz University) who use Berkeley digital library materials for their learning and teaching process.

1.10) DEFINITION OF IMPORTANT TERMS

Several authors have pointed out that little work is being done to understand usability of digital libraries in any context (Blandford, Buchanan, 2002[12]-2003[13], 69; Byran-Kinns, Blandford, and Thimbleby 2000[18], 181; Borgman et al. 2000[16], 229; Theng, Mohd-Nasir, and Thimbleby 2001[138], 238; Thomas 1998[141]; Stelmaszewska & Blandford, 2004[133]; and Judy Jeng, 2005a[66], 2005b[67]). There are a number of methods to evaluate usability of digital libraries according to Askin, 1998[7]; Blandford et al. 2004[14]; Nicole Compbell 2001[101]; Kantner and Rosenbaum 1997[72]; Keith et al. 2003[77]; Nielson and Mack 1994[104]; Pearrow 2000[109]; Popp 2001[113]; Rosson and Carroll 2002[122]; Snyder 2003[132]. However, for the purpose of this study the following definitions are provided.

1.10.1 USABILITY

Furtado et al. (2003)[44] considered "usability" from ease of use point of view and added that usability should include ease of learning. International Standards Organization (ISO) defined usability as:

> "The context to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use".

According to Nilson (2003); Kim, Kyunghye (2002)[79]; and Judy Jeng (2005a[66], 2005b[67]) the usability of a system can have four quality components as follows:

1. Learnability: how easy is it for the assimilation of distinct ways of using DL?

2. Efficiency: how quickly users (learners) can perform tasks?
3. Satisfaction: how pleasant it is to use the design?
4. Effectiveness: how many answers are correct?

1.10.2 ACTIVE LEARNING

In active learning, learners take responsibility for their own education and study strategies to accomplish their goals (Lee & Kim, 1999[84]). Active learning consists of Active Consuming (active reading, active watching, and active listening), Information Gathering (constructing the user's reference collection with ease), and Information Seeking (facilities are needed to locate suitable materials) which are hereby measured by browsing and searching attributes.

1.10.3 DIGITAL LIBRARIES

From the previous section in the definition part of the digital library, this research can pay attention to the following definitions of the digital libraries: IBM (1994)[63] definitions are more of a hybrid digital library, one that includes the features of traditional libraries.

The researcher can define digital library as a means that include a collection of information, which includes video, audio, documents, articles, journals, periodicals, etc. that use to enhance learners' skills, and cognitive and increase learning (formal and informal) outcomes using some activities.

REFERENCES

[1] Adachi, J. (2000). NACSIS-ELS: Digital library of Tapanese academic joumals. *In Proceedings of the 3rd International Conference on Asian Digital Library.* (pp. 15-22). Seoul, Korea.

[2] Agarwal, R., & Day, A. E. (1998). The impact of Internet on economic education. *Journal of Economic Education, 29*, 99-110.

[3] Alexander, P. A., & Knight, S. L. (1993). Dimensions of the interplay between learning and teaching. *Educational Forum, 57*, 232-245.

[4] Altman H. B. and James C. V. (Eds.) (1980). *Foreign Language Teaching: Meeting Individual Needs*, Oxford: Pergamon Press.

[5] Andy Dong and Alice M. Agogino (2001). Design principles for the information architecture of a SMET Education Digital Library *In IEEE/ACM Joint Conference on Digital Libraries.* Roanoke, VA, USA. Available at URL: www.engineeringpathway.com/smete/public/about_smete/publications/JCDL-0601/dongagoginojcdl01-01.pdf.

[6] Arms, W. Y., Blanchi, C. & Overly E. A. (1997). An Architecture for Information in Digital Libraries. *D-Lib Magazine.*

[7] Askin, A. Y. (1998). Effectiveness of usability evaluation methods at a function of users' learning stages. Master's thesis, Purdue University.

[8] Barnes, S. (2000). What does electronic conferencing afford distance education? *Distance Education 21*, 236-247.

[9] Becker, H. J., & Ravitz, J. L. (2001). *Computer use by teachers: Are Cuban's predictions correct?* Paper presented at the American Educational Research Association, Seattle, WA.

[10] Becker, H. J., & Riel, M. M. (2000). Teacher professional engagement and constructive-compatible computer usage. *Teaching, Learning, and Computing.* Retrieved February 28, 2009, from http://www.crito.uci.edu/tlc/findings/report_7/

[11] Bickel, B., & Truscello, D. (1996). New opportunities for learning: Styles and strategies for computers. *TESOL Journal, 6(1)*, 15-19.

[12] Blandford, A., & Buchanan, G. (2002). Workshop report: Usability of Digital Libraries @ JCDL'02. SIGIR Forum, 36 (2), 83-89.

[13] Blandford, A., & Buchanan, G. (2003). *Usability of digital libraries: A source of creative tensions with technical developments.* TCDL Bulletin. Retrieval April 12, 2009 from: http://www.ieee.tcdl.org/Bulletin/v1n1/blandford/blandford.html.

[14] Blandford, Ann, et al. (2004). Analytical usability evaluation for digital libraries: A case study. *Proceedings of the fourth ACM/IEEE Joint Conference on Digital Libraries.* New York: ACM Press, 27-86.

[15] Borgman, C. L. (1996). Social aspects of digital libraries. In: E. A. Fox & G. Marchionini (Eds.), *Proceedings of the 1st ACM International Conference on Digital Libraries* pp. (170-171). Bethesda, MD.

[16] Borgman, C. L., Leazer, G. H., Gilliland-Swetland, A. J. & Gazan, R. (2000). Evaluating digital libraries for teaching and learning in undergraduate education: A case study of the Alexandria digital earth prototype (ADEPT). *Library Trends, 49(2),* 228-250.

[17] Bruce, B., Peyton, J. K., & Baston, T. (Eds.). (1993). *Network-based classrooms: Promises and realities.* Cambridge, England: Cambridge University Press.

[18] Byran-Kinns, N., Blanford, A., & A thimbleby, H. (2000). Interaction modeling for digital libraries. In Workshop on Evaluation of Information Management System. Landon, UK.

[19] Byrne, A. (2003). Digital libraries: Barriers or gateways to scholarly information? *The Electronic Library,* 21 (5), 414-421.

[20] Carico, K. M., & Logan, D. (2004). A generation in cyberspace: engaging readers through online discussions. *Language Arts, 81,* 293-302.

[21] Chan, C. H., Sun, A., & Lim, E. P. (2001). Automated online news classification with personalization. *In Proceedings of the 4th International Conference on Asian Digital Library Workshop.* (pp. 320-329). Bangalore, India.

[22] Chapelle, C. A. (2001). *Computer-applications in second language acquisition: Foundations for teaching, testing and research.* New York: Cambridge University Press.

[23] Chen, H. (2003a). *Towards building digital library as an institution of knowledge.* Paper presented at wave of the Future: NSF Post Digital Libraries Futures Workshop, June 15-17, Chathman, Massachusetts. Retrieved from the World Wide Web: http://www.sis.pitt.edu/%7Edlwkshop/paper-chen.html

[24] Chen, S. C. (1996). The spread of English in Taiwan: A social linguistic study. *Proceedings of the 13th Conference on English Teaching and Learning in Republic of China,* 321-330.

[25] Chen, Z., Liu, W. Y., Zhang, F., Li, M. J. and Zhang (2001). Web mining for web image retrieval. *Journal of American Society for Information Science and Technology, 52 (10)*: 831-839, 2001.

[26] Cheng, Y. C. (1999). *BBS as a virtual EFL Learning community: Research and implications.* Retrieved August 1, 2009, from http://mavis@mradio.url.com.tw.

[27] Chiu, C. M. (1997). Fusing the World Wide Web and open hypermedia system technologies (Doctoral dissertation, Rutgers University, 1997). *ProQuest Dissertation Abstracts*, AAC.

[28] Cradler, J., & Cradler, R. (1995). *Prior studies for technology insertion.* San Francisco: Far Web Laboratory.

[29] Cuban, L., & Kirkpatrick, H. (1998). Computers make kids smarter-right? *Techos, 7*(2), 1-6.

[30] Cunningham, S. J., & Mahoui, M. (2000). Search behavior in two digital libraries:A comparative transaction log analysis. *In Proceedings of the 3rd International Conference on Asian Digital Library.* (pp. 193-200). Seoul, Korea.

[31] Dagobert Soergel (2008). *Digital libraries and knowledge organization.* Retrieved May 29, 2009, from the World Wide Web: www.desoergel.com/newPublications/SoergelDigitalLibrariesandKnoledge Organization.pdf

[32] Di Sessa, A. A. (1988). What will it mean to be educated in 2020? In: R. S. Nickerson and P.P. Zodhiates, (editors), Technology in Education: Looking Toward 2020. Hillsdale, N. J.: Erlbaum, pp. 43-66.

[33] Dickensen L. (1987). *Self-instruction in Language Learning*, Cambridge University Press.

[34] Dorward, J., Reinke, D., & Recker, M. (2002). An evaluation model for a digital library. *In Proceedings of Joint Conference of Digital Libraries* (pp. 322-323). New York: ACM.

[35] Dueme, L., Fontenot D., Gumfory K., Kallus M., Larsen J., Schafer., et al. (2002). The use of online synchronous discussion groups to enhance community

formation and professional identity development. *Journal of Interactive Online Learning 1*, Retrieved April 9, 2009, from http://www.ncolr.org/jiol/ARCHIVES/2002/2/04/

[36] Dunn, R. (1983). Learning style and its relation to exceptionality at both ends of the spectrum. *Exceptional Children*, 49, 496-506.

[37] Dunn, R. (1984). Teaching students through their perceptual strength or preferences. *Journal of Reading, 31*, 304-309.

[38] Edward A. Fox. Overview of Digital Library Component and Development. USA.

[39] Ellis G. and Sinclair B. (1987). *Training for Learners of English* (Pilot Edition), Cambridge University Press.

[40] Farrington, G. (1994). Penn's plans for integrating emerging technologies. *The Technological Horizons in Educational Journal, 22 (3)*, 104-106.

[41] Florini, B. M. (1989). Teaching Styles and Technology. *New Directions for Continuing Education, 43*, 41-53.

[42] Fox, E. A., Akscyn, R. M., Furuta, P. K. and Leggett, J. J. (1995). Digital libraries communications of the ACM, 38 (4), 22-28.

[43] Frizler, K. (1995). The Internet as an educational tool in ESOL writing instruction. Master's thesis, San Francisco State University, San Francisco, CA.

[44] Furtado, Elizabeth, Joao Jose Vasco Furtado, Feranando Lincoln Maths, and Jean Vanderdonckt (2003). Improving usability of online learning system by means of multimedia, collaboration and adaptation resources. In Usability evaluation of online learning programs, ed. Claude Ghaoui, 69-86. Hershey, PA: Information Science Publishing.

[45] Garrison, D. R. (2003). Cognitive presence for effective asynchronous online learning: The role of reflective inquiry, self-direction and metacognition. In J. Bourne & J.C.

[46] Geddes M. and Sturtridge G. (1982). *Individualization*, London: Modern English Publications.

[47] Giles, C. L., Bollacker, K., & Lawrence, S. (1998). CiteSeer: An automatic citation indexing system. *Proceedings of the International Conference on Digital Libraries*, (pp. 89-98).

[48] Gopen D. Key (1993). In Rama Nand Malviya (2008). Digital Library & Academic Society in India (1st ed.). New Delhi, Asian Books Ptiuate Limited, pp. 2-3.

[49] Graham, M. & Scarborough, H. (1999). Computer mediated communication and collaborative learning in undergraduate distance education environment. *Australian Journal of Education Technology, 15(1),* 20-46.

[50] Green, L. (1998). *Online conferencing: Lessons learned. Office of Learning Technologies, Government of Canada.* Retrieved April 9, 2009, from http://emoderators.com/moderators/lessonse.pdf.

[51] Greenburger, M. (1995). East meets west: A multicultural look at multimedia. *Education review, 30 (1),* 25-30.

[52] Gregorc, A. F., & Ward, H. B. (1977). A new definition for individual. NASSP Bulletin.

[53] Groeling, T. (1999). Virtual discussion - Web-Based discussion forums in political science. Paper presented at *the annual meeting of the American Political Science Association.* Retrieved April 8, 2009, from http://pro.harvard.edu/abstracts/009/009001GroelingTi.html.

[54] Hamblin, Y., & Stubbings, R. (2003). *The implementation of Metalib and SFX at Looghborough University Library: A case study.* Retrieved March 8, 2009, from the World Wide Web: www.jisc.ac.uk/uploaded_documents/Metalibcasestudy.pdf

[55] Harasim, L., Hiltz, S. R., Teles, L., & Turoff, M. (1995). *Learning networks: A field guide to teaching and learning online.* Cambridge, MA: MIT Press.

[56] Hazari, S. (2004). Strategy for assessment of online course discussions. *Journal of Information Systems Education, 15,* 349-355.

[57] Heb, M., & Drobink, O. (1999). Clustering specialized Web-databases by exploiting hyperlinks. *In Proceedings of the 2nd International Conference on Asian Digital Library Workshop.* (pp. 10-29). Taipei, Taiwan.

[58] Ho, C. H., & Swan, K. (2007). Evaluating online conversation in an asynchronous learning environment: An application of Grice's cooperative principle. *Internet and Higher Education, 10,* 3-14.

[59] Horton, W. (2001). *Evaluating e-Learning.* Alexandria, VA: ASTD.

[60] Hsinchun Chen, Yilu Zhou. (2005). Survey and History of Digital Library Development in the Asia Pacific. Design and Usability of Digital libraries (pp.2). INFOSCI.

[61] Hu, Y., Li, H., Cao, Y., Meyerzon, D., & Zheng, Q. (2005). Automatic extraction of titles from general documents using machine learning. *Proceedings of the Joint Conference on Digital Libraries*, (pp. 145-154).

[62] Ian Rowlands & David Bawden (1999). Digital libraries: *A conceptual Framework. Libr., vol 49*, pp. 192-202.

[63] IBM. (1994). *Digital libraries: gross structure and requirement creport from the workshop*. [Online] available (Accessd 9 July 2009) www: http://www.ifla.org/documents/libraries/net/rj9840.pdf.

[64] Im, Y., & Lee, O. (2004). Pedagogical implications of online discussion for preservice teacher training. *Journal of Research on Technology in Education, 36*, 155-170.

[65] Ismail Fahmi (2003). Development of Indonesia's National Digital Library Network, *In Design and Usability of Digital Libraries (2005)*. (pp. 38-54).

[66] Jeng, J. (2005a). Usability assessment of academic digital libraries: Effectiveness, Efficiency, Satisfaction, and Learnability. *LIBRI, 55(2-3)*, 96-121.

[67] Jeng, J. (2005b). What is usability in the context of digital library and how can it be measured? *Information Technology and Libraries 24(2)*, 47-56.

[68] Joe, S. G., & You, Y. L. (2001). *Investigating the metacognitive awareness and strategies of English-majored university student writers*. In Selected papers from the Tenth International Symposium on English teaching, Taiwan, ROC (pp. 106-119).

[69] Jonassen, D. (1996). Computers in the Classroom: Mindtools for Critical thinking, Englewood Cliffs, N. J.: Merrill.

[70] Jonassen, D. H., Peck, K. L., & Wilson, B. G. (1999). *Learning with technology: A constructivist perspective*. Upper Saddle River, NJ: Prentice-Hall.

[71] Jones, S., & Mahoui, M. (2000). Hierarchical document clustering using automatically extracted key phrases. *In Proceedings of the Third International Conference on Asian Digital Library* (113-120). Seoul, Korea.

[72] Kantner, Laurie, and Stephanie Rosenbaum (1997). Usability studies of www sites: Heuristic evaluation vs. laboratory tesling. *Proceedings of the 15th Annual International Conference on Computer Documentation*, 153-160. New York: ACM Press.

[73] Kaput, J. (1991). Technology in education research: The first 25 years in the JRME. *Journal for Research in Mathematics Education, 25*, 667-681.

[74] Kauffman, D., & Hamza, M. K. (1998). Education reform: Ten ideas for change plus or minus two, *Association far the Advancement of Computer in Education SITE Conference*, Washington, D. C.

[75] Keefe, J. W. (1987). Learning style theory and practice. Reston, VA: NASSP.

[76] Keefe, J.W. (1979a). Learning styles: An overview. In J. W. Keefe (Ed.), Student learning styles: Diagnosing and prescribing programs (pp. 1-17). Reston, VA: National Association of Secondary School Principals.

[77] Keith, Suzette, Ann Blondford, Bob Fields, and Yin Leng Theng (2003). An investigation into the application of claims analysis to evaluate usability of a digital library interface. Paper presented at the usability workshop of JCDL 2002. http://www.uclic.ac.uk/annb/DLUsability/Keith15.pdf (accessed June 19, 2009).

[78] Kemp, F. (1993). The origins of ENFI, network theory, and computer-based collaborative writing instruction at the University of Texas. In B. Bruce, J. K. Peyton, & T. Baston (Eds.), *Network-based classrooms: Promises and realities* (pp. 161-180). Cambridge, England: Cambridge University Press.

[79] Kim, Kyunghye. (2002). A model of digital library information seeking (DLISP model) as a frame for classifying usability problems. PhD diss., Rutgers University.

[80] Kling, R., & Courtright, C. (2003). Group behavior and learning in electronic forums: a sociotechnical information society. *Information Society, 19*, 221-135.

[81] Knowlton, D. S., & Knowlton, H. M. (2001). The context and content of online discussions: making cyber-discussion viable for the secondary school curriculum. *American Secondary Education 29*, 38-52.

[82] Lapadat J. C. (2002). Written interaction: A key component in online learning. Retrieved April17,2009,from http://www.ascusc.org/jcmc/vol7/issue4/lapadat#asynchronous.

[83] Larson, Ray R. (1994). *Design and development of a network-based electronic library*.(http://sherlock.berkeley.edu/diglib/asis.html). (ray@sherlock.berkeley.edu).

[84] Lee, J. H. and Kim, M. H. (1999). Enhancing fuzzy set model for high quality document rankings. *Proceedings of the 19th Euromicro Conference*. Paris. Pp. 337-340.

[85] Lee, K. W. (2000). English teachers' barriers to the use of computer-assisted language learning. *The Internet TESL Journal*. Retrieved July 28, 2009, from http://iteslj.org/Articles/Lee-CALLbarriers.html.

[86] Lesk (1997). In Rama Nand Malviya (2008). Digital Library & Academic Society in India (1st ed.). New Delhi, Asian Books Ptiuate Limited, pp. 2-3.

[87] Levy, D. M., & Marshall, C. C. (1995). Going digital: a look at assumptions underlying digital libraries. *Communications of the ACM*, 38 (4), 77-84.

[88] Liew, C. L., Foo, S., & Chennupati, K. R. (2000). Enhancing user interaction with electronic journals via interactivity and value-adding features. *In Proceedings of the 3rd International Conference on Asian Digital Library*. (pp. 289-294). Seoul, Korea.

[89] Lim-Youngsook (1996). The Effectiveness of Multimedia Presentation Tools in Teaching Perspective Drawing for Interior Design Students. Unpublished doctoral dissertation, University of Minnesota.

[90] Liu, H. C. (2001). Incorporating computers into English classrooms: Curriculum design issues. In Selected papers from the tenth international symposium on English teaching (pp.120-131). Taiwan: ROC.

[91] Liu, M. Y., & Chen, C. Y. (2004). Acquiring English Relative Clauses. *English Teaching and Learning, 29(1)*, 23-52.

[92] Lynch, Clifford and Garcia-Hector. (1995). (Eds.) Inter-operability, scaling and the digital libraries research agenda. A report on the May 18-19 1995 IITA Digital Libraries Workshop. (Clifford.lynch@ucop.edu) , (hector@db.standford.edu) (http://www.diglib.standford.edu/diglib/pub/reports/iitadlw/main.html).

[93] McAlister S., Ravenscroft, A., & Scanlon, E. (2004). Combining interaction and context design to support collaborative argumentation using a tool for synchronous CMC. *Journal of Computer Assisted Learning, 20*, 194-204.

[94] McDonald, J. (2002). Is "as good as face-to-face" as good as it gets? *Journal of Asynchronous Learning Networks*, 6, 10-23.

[95] McDonald, M. (1996). The impact of multimedia instruction upon student attitude and achievement and relationship with learning styles. Unpublished doctoral dissertation, University of Nebraska-Lincoln. Dissertation Abstracts International, 57 (08A), 3466.

[96] Means, B., Ed. (1994). *Technology and education reform*. San Francisco, CA: Jossey-Bass.

[97] Means, B., Olson, K. (1997). *Technology and education reform*. Retrieved July 8, 2004, from http://www.ed.gov/pubs/SER/Technology/title.html.

[98] Michael Lesk (2005). Understanding Digital Libraries. 2nd edition, (pp. 9-12).

[99] Morgan, W., & Beaumont G. (2003). A dialogic approach to argumentation: Using a chat room to develop early adolescent students' argumentative writing. *Journal of Adolescent & Adult Literacy*, *47*, 146-158.

[100] Munro T. and Pringle I. (2009). Using Open and Distance Learning for Community Development. (In: Baksh R. and Munro T. (2009). Learning to Live Together Using Distance Education for Community Peace building, Commonwealth of Learning, Vancouver)

[101] Nicole Compbell (2001). Usability Assessment of Library-Related Web Sites: Methods and Case Studies. American Library Association. Chicago, Illinois, 2001 pp.125.

[102] Nielsen (2003). Usability 101: Introduction to usability. Useit.com: Usable Information Technology. Use Net Alterbox, August. Disponivel em: http://www.useit.com/alterbox/20030825.html.

[103]Nielsen, J. (1993). Usability Engineering. San Diego, CA: Academic Press.

[104] Nielson, Jakob, and Robert L. Mack, eds. (1994). *Usability inspection methods*. New York: Wiley

[105] O'Malley J. M., Chamot A. U., Stewner-Manzares G., Kupper L. and Russo R. P. (1985a). 'Learning strategies used by beginning and intermediate ESL students'. *Language Learning*, *35*(1), 21-46.

[106] Ong, T. H., & Chen, H. (1999). Updateable PAT-Tree approach to Chinese key phrase extraction using mutual information: A linguistic foundation for knowledge management. *In Proceedings of the 2nd Asian Digital Library Workshop.* (pp. 63-84). Taipei, Taiwan.

[107] Oppenheim, C. & D. Smithson (1999). What is the hybrid library? *Journal of Information Science*, 25 (2): 97-112.

[108] Panitz, T. (1999). *The case for student centered instruction via collaborative learning paradigms.* Retrieved July 22, 2009, from http://home.capecod.net/~tpanitz/tedsarticles/coopbenefits.htm.

[109] Pearrow, Mark (2000). *Web site usability handbook.* Rockland, MA: Charles River Media.

[110] Pilkington, R., & Bennett, C. (2000). An evaluation of computer mediated communication to support group discussion in continuing education. *Educational Technology & Society, 3,* 349-360. Retrieved April, 9, 2008, from http://ifets.massey.ac.nz/periodical/vol_3_2000/d10.pdf.

[111] Pogrow, S. (1994). Helping students who just don't understand. *Educational Leadership,* 52 (3), 62-66.

[112] Poole, D. M. (2000). Student participation in a discussion-oriented online course: A case study. *Journal of Research on Computing in Education, 33,* 162-177.

[113] Popp, Mary Pagliero (2001). Testing library Web sites: ARL libraries weigh in. Paper presented at the Association of College and Research Libraries, 10th National Conference, Denver, Color-ado, March 15-18, 2001. http://www.ala.org/ala/acr/acrlevents/popp.pdf.

[114] Purbo, O. W. (2004). When east meet west: In ICT4D. IDRC Sabbatical paper. Retrieved March 25, 2004, from the World Wide Web: http://sandbox.bellanet.org/~onno/ict4d-roadmap/when-east-meet-west-in-ict4d-doc

[115] Rama Nand Malviya (2008). Digital Library & Academic Society in India: Features of digital libraries. Kamal Jagasia for Asian Books Pvt. Ltd. New Delhi. (p.7).

[116] Rama Nand Malviya (2008). Digital Library & Academic Society in India: Advantages of Digital Library. Kamal Jagasia for Asian Books Pvt. Ltd. New Delhi. (p. 8).

[117] Recker, M., Dorward, J., Dawson, D., Halioris, S., Liu, Y., Mao, X., et al. (2005a, June). *You can lead a horse to water: Teacher development and use of digital library resources*. Paper presented at the Fifth ACM/IEEE Joint Conference on Digital Libraries, Denver, CO.

[118] Recker, M., Dorward, J., Dawson, D., Mao, X., Liu, Y., Palmer, B., et al. (2005b). Teaching, designing, and sharing: A context for learning objects. *Interdisciplinary Journal of Knowledge and Learning Objects, 1*, 197-216.

[119] Recker, M., Dorward, J., Nelson, L. (2004). Discovery and use of online learning resources: Case study findings. *Educational Technology and Society, 7*(2), 93-104.

[120] Reinert, H. (1976). The Edmonds learning style identification exercise. Edmonds, WA: Edmonds School District.

[121] Renda, M. E., & Straccia, U. (2002). A personalized collaborative digital library environment. In Proceedings of the 5th International Conference on Asian Digital Library. (pp. 262-274). Singapore.

[122] Rosson, M. B., and J.M. Carrol (2002). *Usability engineering: Scenariio-based development of human-computer interaction*. San Francisco: Morgan Kaufmann.

[123] S. I. Fazzuludin and Chikkamallaiah. (1996). The implications of Internet on Indian library network system. *SIS-96*, 18-20, Jan. '96, Bangalore.

[124] Sahu Rama Kanta (2008). *An Introduction to Education*, (1st Ed). Yemen, Sana'a, Awan Publishers.

[125] Salmon G. (2000). *E-moderating: The Key to Teaching and Learning Online*. London: Kogan Page.

[126] Salomon, G. (1992a). The changing role of the teacher: From information transmitter to orchestrator. In F. K. Oser, A. Dick, & J-L. patty (Eds.), Effective and responsible teaching: The new synthesis (pp. 35-49). San Francisco: Jossey-Bass.

[127] Salomon, G. (1992b). Effects with and of computers and the study of computer-based learning environments. In E. De Corte, M. C. Linn, H. Mandl, & L. Verschaflel (Eds.), Computer-based learning environments and problem solving (pp. 249-263). Berlin, Germany: Rpring-Verlag.

[128] Schultz, R. A. (2003). *The effectiveness of online synchronous discussion.* Retrieved April 9, 2009 from http://ecommerce.lebow.drexel.edu/2003Proceedings/docs/077Schul.pdf

[129] Sheingold, K. (1990). Restructuring for learning with technology: The potential for synergy. In K. Sheingold & M. S. Tucker (Eds.), Restructuring for learning with technology (pp. 9-27). New York:Center for technology in Education, Bank Street College of Education.

[130] Sliwa, S. (1994). Reengineering the learning process with information technology. *Academic*, 80, 8-12.

[131] Smith, A. G. (1998). Criteria for evaluation of Internet resources in a digital library environment. In Proceedings of the 1st Asian Digital Library Workshop. (pp. 81-87). Hong Kong.

[132] Snyder, Carolyn (2003). Paper prototyping: *The fast and easy way to design and refine user interfaces.* Boston: Morgan Kaufmann.

[133] Stelmaszewska, H., & Blandford, A. (2004). From physical to digital: A case study of computer scientists' behavior in physical libraries. *International Journal on Digital Libraries, 4(2)*, 82-92.

[134] Sumner, T., & Dawe, M. (2001). Looking at digital library usability from a reuse perspective. *In Proceedings of Joint Conference of Digital Libraries* (pp. 416-425). New York: ACM.

[135] T. B. Rajashekar (1996). Digital Libraries: Attributes and architecture. *SIS*-96, 18-20, '96, Bangalore.

[136] Terence R. Smith, Lesk (1997). In Rana Nand Malviya (2008). Digital Library & Academic Society in India, (pp. 2-3).

[137] Theeramunkong, T., Wongtapan, C., & Sinthupinyo, S. (2002). Offline isolated handwritten Thai OCR using island-based projection with n-gram models and hidden Morkov Models. *In Proceedings of the Fifth International Conference on Asian Digital Library* (pp. 340-351). Singapore.

[138] Theng, Y. L., Mohd-Nasir, N., Buchanan, G., Fields, B., & Thimbleby, H. (2001). Dynamic digital libraries for children. In E. Fox & C. Borgman (Eds.), Proceedings of ACM/IEEE Joint Conference on Digital Libraries (pp. 406-415). Roanoke, VA: ACM Press.

[139] Thomas, Gwenda (2000). South African virtual library environment: how do we square this circle. [Online] available (Accessed 9 July 2001) WWW: http://www.sun.ac.za./library/Sys2000/thomas.html

[140] Thomas, M. (1995). The effects on achievement scores using dissonant and matched treatments of learning style and/or mastery learning. Unpublished doctoral dissertation, University of Wisconsin-Madison. Dissertation Abstracts International, 57(01A), 93.

[141] Thomas, Rita Leigh (1998). Elements of performance and satisfaction as indicators of the usability of digital spatial interfaces for information-seeking: implications for ISLA. PhD diss., University of Southern, California.

[142] U.S. Congress Office of Technology Assessment. (1995). *Teachers & technology: Making the connection.* Washington, DC: U.S. Government Printing Office.

[143] UNECA. (2003). Digital libraries and virtual libraries: Definitions, Concepts, and Goals. Workshop on Technical Aspects of Building Digital Libraries and Electronic Information Networks. L/ECA/DISD/AVLIN/9.

[144] Vaidya, B., & Shrestha, J. N. (2000). Rural digital library: Connecting rural communities in Nepal. *In Proceedings of the 5th International Conference on Asian Digital Library.* (pp. 354-365). Singapore.

[145] Walfram, D., & Xie, H. (2001). State digital libraries: Development systems for general audiences. *In Proceedings of the 4th International Conference on Asian Digital Library.* (pp. 62-74). Bangalore, India.

[146] Walker, S. A. (2004). Socratic strategies and devil's advocacy in synchronous CMC debate. *Journal of Computer Assisted Learning, 20,* 172-182.

[147] Wallace, D. R., & Mutooni, P. (1999). A comparative evaluation of World Wide Web-based and classroom teaching. *Journal of Engineering Education, 86*(3), 211-219.

[148] Wallace, R. M. (2004). A framework for understanding teaching with the Internet. *American Educational Research Journal, 41(2),* 447-488.

[149] Wallace, R., Soloway, E., Krajcik, J., Bos, N., Hoffman, J., Hunter, H. E., et al. (1998). Artemis: Learner-centered design of an information seeking environment for k-12 education. In Chi pp. 195-202. Los Angeles, CA, USA.

[150] Walters, Donald j. (1998). What are digital libraries? CLIR Issues, No. 4, July/August.
[online] Available WWW: (Accessed 9 July 2009) http://www.clir.org/pubs/issues/issues04.html # dly.

[151] Warschauer, M. (1995). *E-mail for English teaching*. Alexandria, Virginia: TESOL Publications, Inc.

[152] Warschauer, M. (1998). Research technology in TESOL: Determinist, instrumental, and critical approaches. *TESOL Quarterly, 32,* 757-762.

[153] Waters (1992). In Rama Nand Malviya (2008). Digital Library & Academic Society in India (1st ed.). New Delhi, Asian Books Ptiuate Limited, pp. 2-3.

[154] Wattenberg, F. (1998). *A national digital library for science, mathematics, engineering, and technology education*. Retrieved December 29, 2008, from http://www.dlib.org/dlib/october98/wattenberg/10wattenberg.html#contents.

[155] Waxman, H. C., & Bright, G. W. (1993). Research methods and paradigms in technology and teacher education. In H. C. Waxman & G. W. Bright (Eds.) Approaches to research in teacher education and technology (pp. 1-9). Charlottesville, VA: Association for the Advancement of Computers and Education.

[156] Wenden A. (1983). 'The process of intervention'. *Language Learning, 33*(1), 21-103.

[157] Wenden A. (1986). 'What do second language learners know about their language learning?: A second look at retrospective accounts'. *Applied Linguistics,* 7(2), 0-186.

[158] Wenden A. (1987a). ' How to be a success full language learner: Insights and prescriptions from L2 learners'. In Wenden and Rubin (Eds.).

[159] Wiburg, K. M. (1991). Teaching teachers about technology. *Computers in the schools* 8 (1/2/3), 115-129.

[160] Wilson, B. (1991). Technology in higher education: in search of progress in human learning. *Educational Record,* 75, 8-16.

[161] Witten, I. H. (2002). Example of practical digital libraries: Collections built internationally using Greenstone. In Proceedings of the 5th International Conference on Asian Digital Library Workshop. (pp. 67-74). Singapore.

[162] Witten, I. H., & Bainbridge, D. (2002). How to build a digital library. San Francisco: Morgan Kaufmann.

[163] Witten, I. H., Loots, M., Trujillo, M. F., & Bainbridge, D. (2002). The promise of digital libraries in developing countries. *The Electronic Library*, 20 (1), 7-13.

[164] Wong, K. L., Lam, W., & Yen, J. (1999). Interactive Chinese news event detection and tracking. In Proceedings of the 2nd Asian Digital Library Workshop. (pp. 30-46). Taipei, Taiwan.

[165] Yang, C. C., Yen, J., Yung, S. K., & Chung, A. K. L. (1998). Chinese indexing using mutual information. *In Proceedings of the First Asian Digital Library Workshop* (57-64). Hong Kong.

[166] Young-Shwu-Ching, (1996). A study of learner's instructions with and perceptions of a CD-ROM based instructional program on interactive writing. Unpublished doctoral dissertation, Ohio State University. Dissertation Abstracts International, 57 (07A), 2985.

[167] Zhao, Y., Pugh, K., Byers, J., & Sheldon, S. (2002). Conditions for classroom technology innovations. *Teachers College Record, 104(3)*, 482-515.

[168] Zia, L. (2001). *Growing a national learning environments and resources network for science, mathematics, engineering, and technology education: Current Issues and Opportunities for the NSDL program.* Retrieved July 17, 2009, from http://www.dlib.org/dlib/march01/zia/03zia.html.

[169] National Science Digital Library (n.d.) National Science Digital Library. Retrieved March 13, 2009, from http://nsdl.org/

[170] Adams, A., Blandford, A., Budd, D., & Bailey, N. (2005). Organisational communication and awareness: A novel solution. *Health Informatics Journal, 11*, 163–178.

[171] Jayawardana C., K. P. Hewagamage and M. Hirakawa. (2001). Database Systems Lab, Graduate School of Information Engineering, Hiroshima University. *MC Journal of Academic Media Librarianship*, v.8#1, summer 2001.

[172] ISO/IEC JTC1/SC29/WG11/W3703 MPEG-7 (2000). Multimedia content description interface part3 visual, October, 2000.

CHAPTER 2

LITERATURE REVIEW

2.1) REVIEWS RELATED TO DIGITAL LIBRARIES

The creation of the Multimedia Educational Resource for Learning and Online Teaching (http://www.merlot.org/Home.po) in 1997 by the California State University Center for Distributed Learning positioned it to be one of the ancestors of educational digital libraries. It has an extensive collection of links to online resources for undergraduate faculty and students in mathematics, science, and technology as well as links to art, business, education, humanities, and social studies. These resources range in size from entire websites to individual activities. Part of the strength of MERLOT is its emphasis on community. Individual members and faculty from member institutions have contributed to both the development of this digital library as well as the ongoing peer review of resources in its collection.

Visitors to MERLOT can use a basic search, advanced search, or browse lists of resources by subject term. Users can choose to limit search returns based on an advanced search query that makes use of up to 20 metadata fields. Members of the MERLOT community, either the authors or fans of the resources, have contributed the resources in the MERLOT collection.

From the MERLOT catalog record of a resource, the user can connect directly to the resource or link to the peer reviews, contact the authors, or locate other resources with similar topics. The catalog record has a description of the resource and other metadata such as technical format, rights, and primary audience. Member comments or peer reviews written by faculty serving on editorial committees are often associated with the catalog record. Users can contribute "assignments," descriptions of how a particular resource can be used, which can help other users envision the variety of ways that they themselves can use the learning resource. Each visitor to the MERLOT site can establish a personal collection and continually add resources to it. Christel et al (1997)[67] presented usage and evaluation data for abstractions implemented the Info-media Digital Video Library, and discussed implications for video delivery over the Web. Research on video abstractions aided not only users of digital video libraries but also users discovering the increasing amount of digital video material available over the Web. The review by Dillon and Gabbard (1998)[30] restricted learning outcomes of the use of hypermedia in higher education.

Snyder (1998)[81] argued that the use of hypertext makes a different way of learning and teaching possible and simulates active, self-directed, and exploratory learning, in particular. She also pointed out; however, that using potentially innovative technology does necessarily lead to change:

> "No technology ....can guarantee any particular change in cultural practices simply by its 'nature'. A hypertext classroom can be used either to support new theories of reading and writing or to promote traditional approaches to the study of text ... The use and effect of a technology is closely tied to the social context in which it appears" (p. 140).

Windschitl's (1998[93], 2000[94]) work had been a very significant impetus in prompting research questions on the importance of the Web in education. Windschtl particularly emphasized the importance of asking critical questions about the added value of the use of the Web in education.

Digital libraries form a vast area of research & explanation. Being multidimensional by nature, they attract researchers from varied disciplines like education, Technology, Psychology, etc. Researchers in different subjects have discussed issues in the context of digital libraries, such as database of hypermedia, models, concepts of documents, multimedia database, children's behavior, usage and evaluation, etc. For example, Wong et al (1999)[95] brought his so-called hybrid approach and specified a DL as a combination of a special-purpose database and a hypermedia-based UI, and used this combination to formulize DLs with the Z language. Lee and Kim (1999)[56] developed a canonical model for information systems; together with a compositional approach they applied to provide a partial solution for interoperability in DLs. Conzett, J. (2000)[24] discussed that reading topic-related articles engenders some degrees of familiarity with particular words. Nevertheless, follow-up learning activities that use the same material, presented through various kinds of individual and interactive exercises, maximized the chance of the word being retained over the long term. He Daging et al.[26] described a scheme for supporting content-based language learning with a digital library. Daging, Ming's paper, based on the integrated functionalities of collecting, organizing, retrieving, and preserving digital objects in a collection, he converted a DL platform into an integrated and interactive e-learning system. The system, called DiLight, concentrated on organization lecturing slides, videos, reading materials and a student comment into meaningful items/documents, and provided multiple retrieval methods that are suitable for student's varied tasks, needs and references. Students' initial feedbacks were very positive, and demonstrating the usefulness of DiLight, system in their learning processes. Kristmundsson (2000)[54] stated that for the first time in the history of education it could not be assumed that teachers are ahead of their students in a particular field. He referred to technical computer skills, which many students have a better command of than their teachers did. Teachers did maintain their advantage, he immediately added, when helping students converted information into meaningful knowledge. Dong and Agogino (2001)[3] prepared implementation paper that introduced principles for the information architecture of an educational digital library. This work described a concept for a digital library for science, mathematics, engineering and technology education (SMETE), a library with an information architecture designed to meet learners' and educators' needs. The authors proposed the specifications for the information architecture and a visual design of a digital library for communicating knowledge to the audience. The design methodology indicated that a scenario-driven design technique sensitive to the contextual nature of learning offers a useful framework for tailoring technologies that help empower, not hinder, the educational sector. Dong and Agogino[3] determined 4 (four) principles as follows: Principle 1: organize information to provide opportunities for students and educators to create, synthesize, manipulate or debate content rather than merely to passively receive instruction. Principle 2: label resources with pedagogical identifies such as age group, teaching method, and academic standards to indicate educational uses. Principle 3: guide the collection and adaptation of learning elements towards individual learning goals. Moreover, principle 4: optimize search to meet the interests, knowledge, understanding, abilities, and experiences of the users in their roles as educators or students. They took about the design and development of an integrated, interactive, and effective e-learning system called DiLight. Todoran Horea (2002)[46] discussed a basic aspect of real multimedia database management systems: the multimedia data types. He had a brief overview of the audio-visual multimedia data types, which he defined and classified. Then, he presented various input and output technologies, which foster the emergence of new multimedia data types, called here "non audio-visual data types": smell, taste, and touch. Integrating these new data types in multimedia database systems is a very difficult task. He imagined three incipient steps. In addition, Plass and Homer (2002)[76] examined the preferences of Verbalizers and Imagers in multimedia learning. One hundred and three students using a German multimedia software were allowed to look up visual and verbal annotations for unknown words. The results showed that Imagers performed significantly better on words that reminded them of visual annotations than words that reminded them of verbal annotations, whereas Verbalizers showed the opposite pattern. Furthermore, Imagers performed better on propositions that allowed for visual and verbal annotations than on those that allowed only for verbal annotations, whereas Verbalizers performed well on both types of propositions. Song (2002)[82] discussed ten studies on the interaction between students' learning skills and various forms of hypermedia instruction. Castells Manuel (2003)[19] presented works in the context of a multidimensional language for DLs. They described the concepts of documents developed on the notions of views and versions, metadata formats and specifications, and a first-order logic based language. Druin et al. (2003)[31] described the differences in children's collaborative behavior and dialogue when using two different software conditions to search for animals in the digital library. In this study, half children had to 'confirm' their collaborative activities (e.g. both children had to click on a given area to move to that area). The other half used on 'independent' collaboration technique (e.g. just one mouse click allowed the pair to move to that area). The participants in this study were 98 Second and Third grade children (age 7-9 year old) from a suburban public elementary school in Prince George's County, Maryland. The results of the study showed distinct differences between conditions in how children discussed their shared goals, collaborative tasks, and what outcomes they had in successfully finding multimedia information in the digital library. For example, Fuentes, C. A. (2003)[38] reported that students' knowledge of business language was greatly enriched by basing learning on a corpus of business reports and product reviews. The Diognene project developed a Web training environment, based on the ACM Computing Classification Scheme (ACM CCS), for classifying books, journal articles and conference proceedings in the field of computing into a four-level subject hierarch (Vergara et al., 2003)[92]. The Courseware Watchdog is an ontology-based tool for finding and organizing learning materials in a decentralized way, in which the ontology servers as the basis for enhancing both the browsing and searching functions inside the system (Tane et al., 2003)[87].

Dicheva & Dichev (2004)[28] proposed a topic-map based system for building, maintaining and using concept-based ontology-aware digital course libraries.

In the context of digital libraries, research on awareness is scarce. Adams et al. (2005)[1] investigated organizational awareness, referred to awareness of community activities, events, and resources across an organization. They discussed the design and evaluation of a screen saver application as an awareness communication medium in the clinical domain. Ingwersen (1992)[47] and Hansen and Ja¨rvelin (2005)[43] described awareness more formally, classifying it as awareness of people, activities, and objects. Awareness of people referred to know about one's colleagues. Awareness of activities referred to share the same need for information such as search strategies. Awareness of objects referred to access different types of resources such as sharing retrieved objects. Collins et al. (2005)[23] described the design of Science Sifter, a tool that enables researchers and scientists to create and customize information feeds. A unique feature in

Science Sifter is the ability of users to select multiple feeds, aggregate them into one feed, and then use a set of keywords to filter the feed. In this way, Science Sifter had the potential to facilitate efficient information sharing, although no users' studies were reported to validate the effectiveness of the tool.

For example, a clinician would like to be notified with relevant search results whenever there is an important new press release and it is likely that his or her patients make inquiries about this topic. Although these particular studies (and others such as Collins et al. (2005)[23]) were specific to their unique context, they raised important architectural and temporal issues for designing and evaluating awareness mechanisms for digital libraries. Graff (2005)[41] examined differences in web browsing strategies between Imagers and Verbalizers. There were 58 participants, who read information in either a hierarchical or a relational hypertext with the expectation of answering questions on this information. The differences observed between Imagers and Verbalizers were that the former visited more pages in the relational architecture whereas the latter visited more pages in the hierarchical architecture. Els Kuiper et al. (2005)[34] analyzed what research said about the demands that the use of the Web as information resource in education makes on the support and supervision of students' learning processes. They discussed empirical research focusing on the limitations of the actual search strategies of children, as well as theoretical literature that analyzes specific characteristics of the Web and their implications for the organization of education. They concluded that students need support in searching on the Web as well as in developing "information literacy". Based on multiple studies in the UK healthcare domain, In the domain of health informatics, researchers have explored the design and evaluation of alerting services for digital libraries. Buchanan and Hinze (2005)[14] and Hinze, et al. (2006)[45] identified the need for clinicians and patients to track medical knowledge. Hinze et al. (2006)[45] identified several user requirements for alerting in health digital libraries and go on to describe system-level implementation details.

Digital libraries have an important role to play in language education also. Wu and Witten (2006)[96] indicated that digital libraries have untapped potential for supporting language teaching and learning. They described a new scheme for automating topic specific language learning using a specially built digital library. There were exercises of different types are generated automatically from the library content: one that learners undertook individually, one in which learners collaborated in pairs, and one in which a group of learners completed the task. The system aims to foster content-based language learning, which greatly increased students' motivation, fostered long-time recollection, and can be culturally situated in appropriate ways. They provide genre-specific, focused material that is carefully selected and organized. Subject-specific collections provide the opportunity to encounter key terms and grammatical constructions that rarely occur in general texts.

Digital libraries of multimedia can provide a rich and coherent learning context, which aids retention and reinforces learners' knowledge of language. They can promote culturally situated learning by working with collections that introduce the target language's people, history, environment, art, literature, and music. Digital libraries can provide a safe learning community in which teachers share thoughts, tips and lessons plans, and organize collaborative task-based, content-based language projects; and learners meet their peers, exchange learning ideas, and engage in competitive or collaborative tasks. Pedagogically, tuned search and browse facilities can meet the special needs of individual learners and teachers without bogging them down in fruitless tangential explorations. Earlier, Wu and Witten (2006)[96] developed eight activities that are automatically generated from digital library content and utilize the search and retrieval facilities to illustrate new ways of supporting language study. Supporting language learning with digital libraries is particularly relevant in developing countries where the ability to speak another language can make the different between poverty and success. Language education traditionally takes place in classrooms, and many students are denied the opportunity because of scarce resources.

Michal Kosiedowski et al. (2007)[68] discussed an approach at the distributed digital library platform that is widely used within the PIONIER optical network. It presented the methodology for building distributed search and accessed to digital publications that allowed creating a national federation of digital libraries and that is now under investigation for possible use within various application fields including medicine, science and education. Currently, there are 9 (nine) regional and 7 (seven) institutional dlibra-based digital libraries which can be used to present, manage and access digital objects consisting of content (text, sound, video, etc) and metadata those digital libraries were there in the PIONIER network and at least 5 (five) more were planned to be available by the end of 2007. Dhakal Sushan (2007)[85] focused on the use of Open Digital Library in present education scenario and the technical description for the architecture. However, this paper presented with the flavor of Foss and Educational Theme. Dhakal[85] discussed the reasons that appear when using open digital library as follow: if there is a single copy of the literature in the library then only a single user can use. In Open DL numerous user can download the same data object at the same time. The printed copy of the literature is often expensive, unaffordable to the general students of the developing countries. ODLs can solve the problem by giving e access. Often the libraries of the developing nation are limited in the literature they possess. Nevertheless, in the ODL the same literature can be searched in all repositories connected to it. As such even the e-prints available in the libraries of Foreign University can be made available. There is no time limitation. Any time the resource is available and preservation of rare literature is also possible.

Steven Scott et al. (2007)[78] had the project called Pathway which is improving the quality of physics teaching and the number of available physics teachers by providing virtual expert help on issues of pedagogy and content. Mellon's Synthetic Interviews and state-of-art digital video library technology with pedagogical advances developed at Kansas State University, and materials contributed by master teachers. Cornegie Mellon's Informedia Digital Video Library focuses specifically on information extraction from broadcast-quality video and audio content. It operated similarly to a Web search engine but did so by searching on video and audio information. Over forty terabytes, consisting of more than 30,000 hours of online news, documentary, and ethnographic video had been collected, with automatically generated metadata and indices for retrieving videos from this library. The interface had been designed to allow efficient browsing and access to information in spite of errors in the automatically produced descriptors of content, i. e., the metadata, which empirical studies and TREC Video Retrieval evaluations validating the effectiveness of the video library interface.

Enrique Frias-Martinez et al. (2008)[36] examined how users' cognitive styles affect their behavior and perception in digital libraries. Fifty participants took part in this study. Two dimensions of cognitive styles were considered: (a) Field Dependence /Independence; (2) Verbalizer/Imager. The results showed that Intermediate users and Verbalizers had not only more positive perception, but they also completed the tasks in effective ways. Implications for the design of personalized digital libraries were also discussed. Arpit Jan's (2008)[5] work described the design of Intinno, an intelligent Web based learning content management system. The system aimed to circumvent certain drawbacks of existing learning management systems in terms of scarcity of content, lack of intelligent search and context sensitive personalization. The scarcity problem was solved by using Web mining to crawl learning content from the Web. The mined content was then used to automatically generate concept maps. Automatic annotation using the concept maps was used to archive the crawled content into a digital library. Multiparameter indexing and clustering was done to provide intelligent content based search. Finally, algorithms for learning applications like generation of memory maps were proposed.

2.2) REVIEWS RELATED TO EDUCATIONAL DIGITAL LIBRARIES

Some researchers concentrated on specific digital libraries and specific users, in particular, educational digital libraries and learners. Focusing on digital libraries for teaching and learning will enhance students' skills and experience and translate teachers to be the guides of educational processes. Emig (1977)[35] studied various definitions of the learning process by some of the most influential psychologies of the 20^{th} century, discovered clear correspondences between writing and learning. Furthermore, 'writing-to-learn', and specifically the knowledge transforming model (Bereiter & Scardamalia, 1987)[8] had considerable theoretical and empirical backing in educational psychology, as a manifestation of constructivism and creating a variety of opportunities for computing supported collaborative learning. Nelson and Hayes (1988)[70] found that more experienced writers were inclined to employ on issue-driven (writing down preliminary thoughts, looking for supportive sources, reading) rather than a content-driven (exclusive information search, reading, and only then writing) approach. There is also some evidence that at least some successful students tightly integrate information search, reading and writing (Fister, 1992)[37]. GeogDL did not provide an environment for active learning (Lebow, 1993)[55]; it also adopted a pragmatic approach that recognized the importance and usefulness of examinations especially in the Singapore education system.

GeogDL study conducted to engage a group of intergenerational partners involving secondary school students and usability-trained evaluators for the purposes of reinforcing and refining the initial design of GeogDL. Borgman et al. (2000)[12] conducted formative evaluation in formulating design requirements and summative evaluation in judging learning outcomes. Hill et al. (2000)[44]collected feedback about the users' interaction with the interfaces of Alexandria Digital Library, the problems of the interfaces, the requirements of system functionality, and the collection of the digital library. The study was inspired by Carroll's (2000)[17] work on the task-artifact cycle, user-centered strategies such as scenario-based design and claims analysis. Yang (2001)[98] examined learners' problem-solving process in using the Perseus digital library by adopting an interpretive and situational approach. The findings of the study helped designers develop and refine better intellectual tools to facilitate learners' performance. Some studies in how scholars actually work, a number of researchers have noted the interweaving of writing with the consulting of resource, and indeed searching activities. Brockman, Neumann, Palmer, and Tidline (2001)[13] noted,

> "As scholars were finishing one document, they made notes of idea they had to expand for another publication. They ran searches to fill in gaps in their bibliography or quickly checked something, communicated with friends in other places who were helping them gather information, or kept up with departmental discussions about administrative issues." (p. 27).

They divided scholarly writing into a series of somewhat distinct activities (Searching for the information and Organizing, analyzing, systematizing, synthesizing, obtaining insights, planning the report & Writing the report). In this work they summarized the categorization of highly-cited just-in-time information retrieved agents. Alexandria Digital Earth Prototype System (Smith, Janee, Frew, & Coleman, 2001)[80] provided students with "learning spaces" (Coleman, Smith, Buchel, & Mayer, 2001)[22]. Theng et al. (2001)[89] when examining digital libraries for children, embarked on a similar observational study between children in a physical setting – with findings used as refinements to a prototype of a digital library. Jose et al. (2002)[52] argued that a digital library enabling collaboration between peers needed to be equipped with a common workspace as well as communication tools for the sharing of resources and comments. They began with a system design, refined later through their discussion. Kassim and Kochtanek (2003)[53] performed usability studies of an educational digital library in order to understand user needs, find problems, identify desired features, and assess overall user satisfaction. In addition to usability studies, DL evaluation studies also cover system performance and content. Applying multifaceted approaches to the evaluation of Perseus

Project, Marchionini, Paisant, and Komlodi (2003)[64] concentrated on evaluating learning, teaching, system consisting of performance, interface, and electronic publishing, and content comprising of scope and accuracy. In contrast, Druin et al. (2003)[31], while developing a digital library for children, explored collaborative actions in a physical setting between children in order to suggest collaborative technologies for learning between children.

There has been a growing interest in the importance of studying digital library use in context. For example, Carr et al. (2004)[16] pointed out that DLs should not be just a static archive. Instead, DLs should be aware of user's information need and context. The authors called this a 'broadening' view of DLs. This is a natural progression from earlier concentrations on the mechanics of digitization and the collection and aggregation of online resources, the provision of useful search functionalities and the development of better user interfaces.

Some studies use "surrogate users" – subject experts who can better assess features of a DL than the target user population, but who are not usability experts. One example is the work of McCown, Bollen, and Nelson (2005)[66], who recruited eleven teachers to participate in a study comparing the effectiveness of NSDL and Google in terms of the quality of results returned for curriculum-related search expressions. In this case, the evaluation was not of the quality of the interaction or system design, but of the quality of the results returned in relation to the relevant school curriculum. Writing, particularly academic writing can be a challenge for experts and novices alike. Digital libraries have greatly improved the ease with which we can search for information, even from our desktop. It is easier to integrate searching and writing activities when both are done in different windows on the same computer. Nevertheless, the act of writing remains difficult. The very accessibility of so much of information through ever more complete DLs with ever more sophisticated search functionalities can mean that searching and reading articles turns into something of a displacement activity, postponing the dreadful moment of starting work on the paper. Sadly, this kind of problem is one more likely to be experienced by the more diligent, perfectionist student, a personality trait particularly evident at the graduate level.

Twidale et al. (2007)[90] integrated the potential of a tighter integration between searching for information in digital libraries and using those results in academic writing.

2.2.1) EXAMPLES OF EDUCATIONAL DIGITAL LIBRARIES

Multimedia Educational Resource for Learning and Online Teaching (MERLOT)

Digital Library for Earth System Education (DLESE)

The Digital Library for Earth System Education (http://www.dlese.org/dds/index.jsp) also is a community-based project. Educators, students, and scientists work together to improve Earth systems teaching and learning at all levels. The development of this digital library began with funding from the Award to Facilitate Geoscience Education (NSF 97-174) from the Geosciences Directorate of the National Science Foundation.

DLESE provides access to collections of digital Earth systems resources for teachers and learners, such as lesson plans, images, data sets, assessments, and online courses. A subset of exemplary resources is in the DLESE Reviewed Collection (DRC), To insure that the resources are high quality, DRC best practices identify criteria such as scientific accuracy, information about pedagogical effectiveness, and the ease of use of the resource.

Users can find resources with the search or browse features that are described accurately and consistently. Earth system educators, scientists, and librarians to ensure accuracy and relevance to the users create the DLESE descriptions. The records have educational descriptors such as grade level and educational standard. Bibliographic descriptors include creator, technical requirements, and resource type.

Users can find resources by browsing the DLESE collection by subject, resource type, or grade level. The reviewed and thematic collections can also be browsed.

MathDL

MathDL (http://www.mathdl.org/) is a digital library that is funded by NSF, managed by the Mathematics Association of America, and hosted by Math Forum. Math DL provides access to both the *Journal of Online Mathematics and Its Applications (JOMA)* and a collection of digital classroom resources for undergraduate mathematics teaching and learning. Faculty can become part of the MathDL community by contributing resources, peer reviewing resources, or moderating discussions about resources.

The Digital Classroom Resources (DCR) record contains bibliographic (author and title), educational (intended uses and appropriate courses), and technical (software specifications) information about the resource. It also offers a review based on classroom teaching and peer review. Visitors also can link to a moderated discussion about the resource.

Communities for Physics and Astronomy Digital Resources in Education (comPADRE)

The Communities for Physics and Astronomy Digital Resources in Education (http://www.compadre.org/) is designed to help people who belong to or identify with the following institutions: the American Association of Physics Teachers (AAPT), the American Physical Society (APS), the American Astronomical Society (AAS), or the American Institute of Physics/Society of Physics Students (AIP/SPS). Users can find resources from collections focused on the different fields in physics and astronomy. These fields include introductory astronomy, quantum physics, student resources, high school teachers' resources, and public education. When users enter a query in the Physical Science Resource Center on the comPADRE site, they can limit their search by subject, author, and/or organization. It has bibliographic (such as author and cost), educational (such as intended levels and intended users), and technical information (such as format). At this time, comPADRE is not as some of the other mathematics and science educational digital libraries. Among the comPADRE development plans for the next few years are increasing the depth and breadth of the collections, building on the value of the records of the resources by including professional reviews, and establishing community interactions to promote advancement in physics and astronomy teaching and learning.

BiosciEdNet (BEN)

BiosciEdNet (http://www.biosciednet.org/portal/) is a project of the American Association for the Advancement of Science (AAAS) that provides access to life sciences resources for students from preschool through professional and continuing education. When visitors use a basic or advanced search or browse by subject area or resource type, they can open records that display bibliographic (author, publisher); educational (context); and technical information about the resource.

The MicrobeLibrary

The MicrobeLibrary (http://www.microbelibrary.org/) offers access to a peer reviewed collection of digital resources focused on the microbial world for undergraduate faculty and students in the life sciences. The resources in the MicrobeLibrary can also be accessed through BEN. It is linked to the American Society for Microbiology (ASM) recommended core curriculum for introductory microbiology courses. It offers images, activities, articles from the *Focus on Microbiology Education* newsletter, and columns and reviews from the *ASM News*.

The Learning Matrix

The Learning Matrix (http://thelearningmatrix.enc.org) is a digital library collection for undergraduate mathematics and science faculty that was developed at the Eisenhower National Clearinghouse. Its goal is to support the extension of the implementation of the *NSES* for teaching into the undergraduate setting. It contains resources that have been selected for the collection by mathematics and science content specialists and described in bibliographic, educational, and technical terms. The resources range from entire web sites to individual simulations, images, or articles. Educational fields that describe the difficulty, level of interactivity, and suggestions for use can help faculty in their selection and use of the resource. Users can link directly from the catalog record to descriptions of related resources. Users can use a basic or advanced search as well as a browse feature to locate and access resources. The advanced search allows the user to narrow their query by up to 14 different types of descriptors. The collection includes both resources for classroom use and faculty professional development.

iLumina

Faculty can find undergraduate teaching materials for chemistry, biology, physics, mathematics, and computer science in iLumina (http://turing.bear.uncw.edu/iLumina/index.asp). The resources in this digital library range in granularity from individual images and video clips to entire collections of resources or courses. iLumina catalog records offer bibliographic, educational, and technical descriptions of the resources. Users can use a basic or advanced search feature or browse the resources described in the iLumina digital library. The advanced search allows users to limit their queries by descriptors such as subject, keyword, or level of interactivity. Users can browse by discipline, resource type, structure, media type, or contributor. The catalog record describes the resource in bibliographic, educational, and technical terms. Users also can see a description of different collections such as microscopy images, water mold videos, or calculus Maple worksheets. From the overview description of the collection, users can link to a list of all of the individual resources in the collection.

The Virtual Skeletons Project

The Virtual Skeletons Project (http://www.eskeletons.org/) allows visitors to access information about the bones of a human, gorilla, or baboon. The user selects a bone from one of the three organisms and then chooses to see a QuickTime movie about the bone, look at the origin or insertion points, or compare the bone to the same bone in a different organism. The user also can virtually manipulate the bone into other viewing positions.

2.3) REVIEWS RELATED TO USABILITY OF DIGITAL LIBRARIES

Now a days, the characteristic derived from the Internet which the late twentieth century was marked by the following: a boom of the available information and a fast growth in the number of connected computers. Card et al. (1983)[15] showed the mouse to be maximally efficient with respect to human information processing for pointing at objects on screen. Therefore, it is essential to consider both cognitive and operational aspects involved in the process of information search and use (Norman et al., 1986[73]; Dervin & Nilan, 1986[27]). Gould et al. (1987)[40] demonstrated the image polarity, screen resolution and anti-aliasing in combination significantly affected reading speed, and any interface that failed to address two-level issues would serve to slow readers of digital documents by as much as 30%. Within Human-Computer Interaction, there is a higher preponderance of qualitative approaches to evaluating interactive systems, although qualitative approaches based on classic experiments (drawing on techniques developed in Psychology) are also common. Such experiments share many features in common with IR approach outlined above (Tague-Sutcliffe, 1992[86]), in that they involved the identification of independent and dependent variables and the control of confounds that might reduce the reliability of the study. Just as Tague-Sutcliffe (1992)[86] presented a set of three criteria that any study should satisfy (validity, reliability, and efficiency), so within HCI a set of criteria have been identified. Accepted definitions of usability have focused on multiple usability attributes such as learnability, efficiency, memorability, error, and satisfaction (Nielsen, 1993)[72]. There are many issues about documents; especially their stability and multimedia components as well as active elements affect retrieval, presentation, and other DL activities (Levy, 1994)[59]. Van House et al. (1996)[91] focused on query form, fields, instructions, results displays, and formats of images and texts in the iterative design process for the University of California Berkeley Electronic Environmental Library Project. DL interface and usability concerns have been central to many efforts at Xerox PARC. Some of the research considers social issues relating to documents (Hearst, 1996)[61] while other research bridges the gap between paper and digital documents (Hearst, Kopec, Brotsky, 1996)[62]. The great alterations in all the scopes of human activity have only become possible to the extent that the new technological resources of information and communication have been accessible to people without specialized formation in computer science. As a result of innumerable research projects into this direction, one can note that to guarantee and to add value to the systems implies drawing and projecting products and services centered in the user's needs and focused on the way users perform their tasks. In 1997, a study at Virginia Tech of four digital library systems concluded that many have serious usability problems (Kengeri et al, 1997[77]). The Virginia Tech study uncovered an important aspect of the situation, and suggested that it will be years before DL systems are properly understood and used. A pre-test asked about user expectations for a DL, and found that very few have worked with a DL. The post-test showed that user expectations and priorities for various features changed dramatically over the short test period. Thus, it is likely that in general, as DL usage spreads, there will be an increase in understanding, a shift in what capabilities users expect, and a variety of extensions to the interface now considered. Some insight into DL use may result from actual user observation as well as other measures of what documents are read (Levy, 1997)[60].

Covi and Kling (1997)[25] investigated patterns of use of digital libraries using different groups of users, and how vary they were across academic fields and universities. They focused on interviewing potential users and were concerned primarily with university members, rather than considering the population at large. Their study led them to conclude that the development of effective (useful and use) digital libraries needs to take account of the important roles played by other people within the broader system of use (notable colleagues and librarians). In addition, it also considered the views of end users, as well as those of librarians and computer specialists need to be understood for effective design. Furnas and Rouch (1998)[39] found that in searching for information a "one-shot query" is very rare. More typical is an extended and iterative search, which involves opportunism; that is, the searching evolves over a period of time and relies on users being able to follow new (interesting) paths as they appeared, which may not necessarily have been specified at the start of their search. People do not just search for items in digital libraries, but also browse for them. O'Hara et al. (1998)[74] focused on such writing activities in their studies of PhD students' use of libraries. They found that reading and writing were inextricably intertwined. Existing Web-based library interfaces did not support any writing activities, so subjects in this study saved and printed relevant articles, for future organization and annotation. Citing in human-computer interaction research by Shneiderman (1998)[79], human-computer interaction/interface criteria were discussed regarding usability, functionality, efforts as well as task appropriates and failures. Within the DL evaluation criteria, usability is the one that has been most investigated. One important finding about reading activity Adler et al. (1998)[2], Bishop (1998)[9] and Marshal et al. (1999)[65] declared that people do not simply read articles from beginning to end, but rather move between levels of information – for example, from authors and titles to reading the conclusion.

Jones et al. (1999)[51] characterized this distinction as follows: Browsing – users traverse information structures to identify required information; Searching – users specify terms of interest, and information matching those terms is returned by an indexing and retrieval system. Users in turn may browse these results in an iterative manner. Gutwin et al. (1999)[42] discussed the browsing in digital libraries, but tend to focus on how user interfaces they develop can support browsing, rather than considering what browsing is. However, in their discussion of browsing support they did categories the purpose of browsing as follows: Collection evaluation – what is in this collection? Is it relevant to my objectives? Subject exploration – how well does this collection cover area X? In addition, Query exploration – what kind of queries will succeed in area X? how can I access this collection? Dillon (1999)[29] proposed a qualitative framework (termed TIME) for designers and implements to evaluate usability of digital libraries which focuses on user task (T), information model (M) and the ergonomic variables (E).

Bishop's (1999)[99]consideration was of the use of digital libraries by people from different social and economic backgrounds. Her studies indicated that people from different backgrounds (low-income and academic) can easily be put of using digital libraries – small problems tend to be magnified until they deter potential users, and lack of awareness of library coverage often prevents users from understanding what they could get out of the libraries. Marchionini (2000)[63] suggested applying existing techniques and metrics to evaluation digital libraries, such as circulation, collection size and growth rate, patron visits, reference questions answered, patron satisfaction, financial stability. Based on data from the early 2000s, Elaina Norlin and Winters (2001)[33] provided a brief overview of usability testing; suggested Web site guidelines; discussed how to get buy-in from others; and how to plan, prepare, and conduct usability testing. They concluded with on actual case study. Nicole Compbell (2001)[71] provided an overview of usability testing methods and then covered eight case studies illustrating different aspects of usability testing and reported results of evaluations of specific library Web sites. Usability was also extended to performance measures, such as efficiency of interactions, avoidance of user errors, and the ability of users to achieve their goals, effective aspects, and the search context (Blandford & Buchanan, 2002)[10]. Cherry and Duff's (2002)[20] focused on how the digital library was used and the level of user satisfaction with response time, browsing capabilities, comprehensiveness of the collection, print function, search capabilities, and display of document pages. The most evaluated DL services are reference services. For instance, Carter and Janes (2000)[18] analyzed logs of over 3000 questions sent to the Internet Public Library regarding how those questions were asked, handled, answered, or rejected. Electronic journals service of the digital library is another area for evaluation. Researchers like Castells (2003)[19] and Levy, Pierre (2003)[58] had argued about the social, economic and political changes originated by the use of the new technologies of information and communication for the net connected society. Blandford and Buchanan (2003)[11] also examined the classical usability attributes in the context of digital libraries, and they suggested adapting many of these attributes to the evaluation of digital libraries. Some of them, such as learnability, need to be modified because users treat the library system as a tool, not as an object of the study. They are more concerned with building a user perspective into the design cycle than with final evaluation. Ryan (2003)[83] and Thompson (2003)[84] suggested establishing policies and how to integrate usability testing into library Web site development.

Pamela & Sandra (2003)[75] and Jennifer Ward & Hill (2005)[50] were encouraged library staff to evaluate their Web sites. Leslie Johnston (2005)[57] reported on the development and assessment of the public discovery and delivery interface for the Fedora repository system. She covered internal review of the design, classroom testing, and usability testing with faculty and staff. She included a process model for assessments of future library projects.

Claudia Roda et al., (2005)[21] used participatory design techniques to enhance the development of a digital image library of sites of the art history department of the American University of Paris. The project team was composed of students, professors, IT managers, librarians, and administrators. Activities included workshops within the design teams, observations of the slide use in classes, user interviews, and reactions to paper prototypes of Web sites. The authors found that team formation had a high turnover impact on usability design; collection management influenced the usability of the final design; and usability and resource reuses were severely reduced if the services were limited to the classical digital libraries. Judy Jeng (2005a[48], 2005b[49]) concluded that usability is a multidimensional construct. She further proposed an evaluation model for assessment of the usability of digital libraries by examining their effectiveness, efficiency, satisfaction, and learnability. User satisfaction covers ease of use, organization of information, labeling, visual appearance, content, and error correction. The evaluation model was tested, and the results revealed that effectiveness, efficiency and satisfaction are interrelated.

Barbara Cockrell & Jayne (2002)[7] and Elahe Zoni-Sabihi et al. (2006)[32] reported the results of usability testing, often case studies.

In these studies, the evaluation emphasizes more on characteristics of users and their usage patterns related to preferred databases, preferred electronic journals, and their frequency of use (Monopoli, Nicholas, Georgiou, & Korfiati, 2002[69]; Atilgan & Bayram, 2006[6]).

Zani-Sabihi, Ghinea and Chen (2006)[32] reviewed definitions of digital libraries. They focused on two digital collections: Science Direct (www.sciencedirect.com); and the classical Music Library (www.alexanderestreetprees.com/clmu.html). They asked participants (n=48) to find information on each Web site. Based on their experiences and analysis of the data, the researchers reported on the functionality features (n=10), interface/usability characteristics (n=6), and content (n=2) that they would like to see in these Web sites. Next, they compared the suggestions by types of users (novice, intermediate, and advanced).

Ann Blandford et al. (2007)[4] shifted the focus to considering how IR systems, and particularly digital libraries, can be evaluated to assess (and improve) their fit with users' broader work activities. They presented the PRET A Rapporter framework for structuring user-centered evaluation studies and illustrated its application to three evaluation studies of digital library systems.

Xie (2008)[97] investigated user's use, their criteria and their evaluation of two selected digital libraries. Nineteen subjects were recruited to participate in the study.

They instructed to keep a diary for their use of the two digital libraries, rated the importance of digital library evaluation criteria, and evaluated the two digital libraries, their perceived important evaluation criteria and the positive and negative aspects of digital libraries. Finally, the relationships between use of digital libraries and evaluation of digital libraries as well as user's preference, experience and knowledge structure on digital library evaluation are discussed. Xie[97] illustrated the structure and summarization of the results (see Xie 2008[97]).

Teal Anderson and Sayeed Chouhdury (2008)[88] at the Digital Knowledge Center, Sheridan Libraries, and John Hopkins University supported enhancing the usability testing of digital libraries. Their research agenda includes: using quantitative measures; conducting remote testing with users; testing with users; testing with diverse user populations; testing part on whole digital library collections; testing in natural and laboratory settings; and balancing decisions between user feedback and librarian expertise.

2.4) HYPOTHESES

Based on literature review and the explorative studies seventeen main hypotheses have been formulated. They describe the supposed correlation between the learning assessment, usability, activities, active learning and their components. In order to determine the specific usability and learning activities benefits, the correlation with effectiveness, efficiency, satisfaction, learnability, active consuming, information seeking, and information gathering will be discussed using different techniques (Nielsen, 1993[103]; Fox et al., 1995[42]; Jayawardana, 2001; Nielsen 2003[102]; Judy Jeng, 2005a[66], 2005b[67]; and Adams et al., 2005).

These hypotheses are as follow:

H01: The levels of effectiveness (of digital libraries) will have a significant impact on learner's efficiency and satisfaction.

H02: The levels of efficiency will have a significant impact on learner's satisfaction.

H03: The levels of effectiveness will have a significant impact on learner's satisfaction.

H04: The levels of learning activities and usability will have a significant impact on ease of use of the digital library.

H05: The levels of learner's experience will have a significant impact on using the Internet.

H06: The levels of digital library learnability will have a significant impact on ease of learn of the digital library.

H07: The levels of time spend using the digital library will have a significant impact on learner's satisfaction.

H08: The levels of steps to reach the digital library materials will have a significant impact on learner's satisfaction.

H09: The levels of learning activities will have a significant impact on the learner's satisfaction.

H010: The levels of learning activities will have a significant impact on the digital library learnability.

2.5) STRUCTURAL EQUATION MODLING HYPOTHESES

H011: The levels of activities will have a significant impact on active learning.

H012: The usability will have a significant impact on the levels of time spent.

H013: The usability will have a significant impact on the levels of steps.

H014: The usability will have a significant impact on the levels of satisfaction.

H015: The usability will have a significant impact on the levels of learnability.

H016: The active learning will have a significant impact on the levels of information seeking.

H017: The active learning will have a significant impact on the levels of active consuming.

REFERENCES

[1] Adams, A., Blandford, A., Budd, D., & Bailey, N. (2005). Organisational communication and awareness: A novel solution. *Health Informatics Journal, 11,* 163–178.

[2] Adler, A., Gujar, A., Harrison, B. L., O'Hara, K., & Sellen A. (1998). A diary study of work-related reading: design implications for digital reading devices. *In Proceedings of HCI'*98, pp. 241-248.

[3] Andy Dong and Alice M. Agogino (2001). Design principles for the information architecture of a SMET Education Digital Library *In IEEE/ACM Joint Conference on Digital Libraries.* Roanoke, VA, USA. Available at URL: www.engineeringpathway.com/smete/public/about_smete/publications/JCDL-0601/dongagoginojcdl01-01.pdf.

[4] Ann Blandford, Ann Adams, Simon Attfield, George Buchanan, JeremyGow, Stephann Markri, Jon Rimmer, and Claire Warwick (2007). The PRET A Rapporter framework: Evaluating digital libraries from the perspective of information work. *Information Processing and management 44* (2008) 4-21, doi: 10.1016/j.imp.2007.01.021.

[5] Arpit Jan (2008). Intinno: A Web integrated digital library and content management system. Thesis. Indian Institute of Technology Kharagpur. April 2008.

[6] Atilgan, D., & Bayram, O. (2006). An evaluation Turkey. *Journal of Academic Librarianship, 32,* 86-93.

[7] Barbara Cockrell & Elaine Anderson Jayne (2002). How do I find an article? Insights from a Web usability study. *The Journal of Academic Librarianship* 28(3) (2002, May): 122-132.

[8] Bereiter, C., & Scardamalia, M. (1987). The psychology of written composition. Hillsdale, NJ:L. Erlbaum.

[9] Bishop, A. P. (1998). Digital libraries and knowledge disaggregation: the use of Journal Article Components. *In Proceedings of ACM DL*'98, pp. 29-39.

[10] Blandford, A., & Buchanan, G. (2002). Workshop report: Usability of Digital Libraries @ JCDL'02. SIGIR Forum, 36 (2), 83-89.

[11] Blandford, A., & Buchanan, G. (2003). *Usability of digital libraries: A source of creative tensions with technical developments.* TCDL Bulletin. Retrieval April 12, 2009 from: http://www.ieee.tcdl.org/Bulletin/v1n1/blandford/blandford.html.

[12] Borgman, C. L., Leazer, G. H., Gilliland-Swetland, A. J. & Gazan, R. (2000). Evaluating digital libraries for teaching and learning in undergraduate education: A case study of the Alexandria digital earth prototype (ADEPT). *Library Trends, 49(2),* 228-250.

[13] Brockman, W. S., Neumann, L., Palmer, C. L., Tidline, T. J. (2001). Scholarly work in the humanities and the evolving information environment. Digital library federation and council on library and information resources (CLIR), Washington, DC.

[14] Buchanan, G., & Hinze, A. (2005). A generic alerting service for digital libraries. *In: Proceedings of the joint conference on digital libraries* (pp. 131–140). Denver, Colorado, June 7–11.

[15] Card, S., Moran, T. and Newell, A. (1983). The psychology of human-computer interaction. Hillsdale NJ: Lawrence Erlbaum Associates.

[16] Carr, L., Miles-Board, T., Wills, G., Power, G., Bailey, C., Hall, W., et al. (2004). Extending the role of the digital library: computer support for creating articles. *In Proceedings of the 15^{th} conference on hypertext and hypermedia* (pp. 12-21). New York, YN: ACM Press.

[17] Carroll, J. (2000). Making use: Scenario based design of human-computer interactions. Cambridge, MA: MIT Press.

[18] Carter, D. S., & Janes, J. (2000). Unobtrusive data analysis of digital reference questions and service at the Internet Public Library: An exploratory study. *Library Trends, 49*, 251-265.

[19] Castells, Manuel (2003). Licoes da Internet. In: MORAES, Denis de. (org). Por uma Outra Comunicacao: media, mundializacao, cultura e poder. Rio de Janeiro: Record.

[20] Cherry, J. M. & Duff, W. M. (2002). Studding digital library users over time: A follow-up survey of early Canadiana online. Information Research, 7(2), Retrieval March 12, 2009, from http://informationr.net/ir/7-2/paper123.html.

[21] Claudia Roda, Ann M. Borel et al. (2005). Digital image library development in academic environment: designing and testing usability. *OCLC Systems & Services 21 (4)* (2005): 264-284.

[22] Coleman, A., Smith, T., Buchel, O., & Mayer, R. (2001). Learning spaces in digital libraries. In P. Constantopoules & I. T. Sølvberg (Eds.), Research and Advanced Technology for Digital Libraries, ECDL 2001: Lecture Notes in Computer Science 2163 (pp. 251-262). Berlin: Springer-Verlag.

[23] Collins, L. M., Mane, K. K., Martinez, M. L. B., Hussell, J. A. T., & Luce, R. E. (2005). ScienceSifter: Facilitating activity awareness in collaborative research groups through focused information feeds. *In First international conference on e-Science and grid computing* (pp. 40–47). Melbourne, Australia: IEEE Computer Society, December 5–8.

[24] Conzett. J. (2000). Integrating collocation into a reading and writing course. In teaching Collocation. Edited by Lewis Michael, pp. 70-87. LTP, England.

[25] Covi, L. & Kling, R. (1997). Organizational dimensions of effective digital library use: Closed rational and open natural systems model. In Kiesler, S. Culture of the Internet, Lawrence Erlbaum Associates, New Jersey, pp. 343-360.

[26] Daging He, Ming Mao, Yefei Peng. *DiLight: a digital library based e-learning environment for learning digital libraries.* Available at the URL: www.sis.pitt.edu/~daqing/docs/dilightelearnfinal.pdf

[27] Dervin, Brenda; Nilan, Michael (1986). Information needs and uses. *ARIST, Vol. 21*, pp. 3-33.

[28] Dicheva, D. & C. Dichev (2004). A framework for Concept-based digital course libraries. *Journal of Interactive Learning Research, 15 (4)*. 347-64.

[29] Dillon, A. (1999). Evaluating on TIME: A framework for the expert evaluation of digital library interface usability. *International Journal on Digital Libraries. 2 (2/3)*, 170-177.

[30] Dillon, A., & Gabbard, R. (1998). Hypermedia as an educational technology: A review of the quantitative research literature on learner comprehensive, control and style. Review on Educational Research, 68(3), 322-349.

[31] Druin, A., Bederson, B., & Hourcade, J. P. (2003). Designing a digital library for young children: An intergenerational partnership. In E. Fox, & C. Borgman (Eds.), *Proceedings of ACM/IEEE Joint Conference on Digital Libraries* (pp. 398-405). Roanoke, VA: ACM Press.

[32] Elahe Zani-Sabihi, Gheorghita Ghinea, & Sherry Y. Chen (2006). Digital libraries: what dousers want? *Online Information Review 30 (4)* (2006): 395-412.

[33] Elaina Norlin & CM! Winters (2001). Usability testing for libraries (Chicago, Illinois: American Library Association, 2001), p. 125.

[34] Els Kuiper, Monique Volman, and Jan Terwel (2005). The Web as Information Resorsce in K-12 Education: Strategies for Supporting Students in searching and processing. *Review of Educational Research Fall 2005, Vol. 75*, No. 3, pp. 285-328.

[35] Emig, J. (1977). Writing as a model of learning. *College Composition and Communication*, 28 (2), 122-128.

[36] Enrique Frias-Martinez, Sherry Y. Chen_, Xiaohui Liu (2008) Investigation of behavior and perception of digital library users: A cognitive style perspective. *International Journal of Information Management* 28 (2008) 355–365.

[37] Fister, B. (1992). The research processes of undergraduate students. *Journal of Academic Librarianship*, 18(3), 163-169.

[38] Fuentes, C. A. (2003). The use of corpora and IT in a comparative evaluation approach to oral business English. *RecCALL, 15(2)*. PP. 189-201.

[39] Furnas, G. W., & Rouch, S. J. (1998). Considerations for information environments and the NaviQue workspace. *Proceedings of ACM DL'98*, pp. 79-88.

[40] Gould, J. D., Alfaro, L., Barnes, V., Finn, R., Grischkowsky, N. and Minuto, A. (1987). Reading is slower from CRT displays than from paper: attempts to isolate a single variable explanation. *Human Factors, 29 (3)* 269-299.

[41] Graff, M. (2005). Individual differences in hypertext browsing strategies. *Behaviour and Information Technology, 24(2)*, 93–99.

[42] Gutwin, C., Paynter, G. Witten, I., Nevill – Manning, C., & Frank, E. (1999). Improving browsing in digital libraries with keypharse indexes. *Journal of Decision Support Systems, 27 (1-2)*, 81-104.

[43] Hansen, P., & Ja¨rvelin, K. (2005). Collaborative information retrieval in an information-sensitive domain. *Information Processing and Management, 41*, 1101–1119.

[44] Hill, L. L., Carver, L., Larsgaard, M., Dolin, R., Smith, T. R., Frew, J. et al. (2000). Alexandria digital library: User evaluation studies and system design. *Journal of the American Society for Information Science, 51*, 246-259.

[45] Hinze, A., Buchanan, G., Jung, D., & Adam, Anne. (2006). HDLalert – A healthcare DL alerting system: From user needs to implementation. *Health Informatics Journal, 12(2)*, 121–135.

[46] Horea Todoran (2002). *The road to real multimedia database emerging multimedia data types*. STUDIA UNIV. BABES-BOLYAI, INFORMATICA, Volume XLVII, Number 2.

[47] Ingwersen, P. (1992). Information retrieval interaction. Taylor Graham, London.

[48] Jeng, J. (2005a). Usability assessment of academic digital libraries: Effectiveness, Efficiency, Satisfaction, and Learnability. *LIBRI, 55(2-3)*, 96-121.

[49] Jeng, J. (2005b). What is usability in the context of digital library and how can it be measured? *Information Technology and Libraries 24(2)*, 47-56.

[50] Jennifer Ward & Steve Hill (2005). Usability testing: Interface design, and portals. *Journal of Library Administration 43 (1/2)* (2005): 155-171.

[51] Jones, S., McInnes, S., & Staveley, M. (1999). A graphical user interface for Boolean query specification. *Internal Journal on Digital Libraries*, Vol. 2, Issue 2/3, pp. 207-223.

[52] Jose, J. M., Braddick, H. Martin, I., Robertson, B., Walker, C., & Macpherson, G. (2002). Virtual tutor: A system for deploying digital libraries. In E. P. Lim, S. Foo, C. Khoo, H. Chen, E. Fox, S. Urs & T. Costantino (Eds.), *Proceedings of 5th International Conference on Asian Digital Libraries* (pp. 275-286). Germany, Springer.

[53] Kassim, A. R. C., & Kochtanek, T. R. (2003). Designing implementing, and evaluating an educational digital library resource. *Online Information Review*, 27 (3), 160-168.

[54] Kristmundsson, G. (2000). Betekenisoval leren en nieuwe media. [meaningful learning and new media.] In P. Bemelen & J. Letschert (Eds.), Op de schouders van de voorgangers. Enschede, The Netherlands; SLO.

[55] Lebow, D. (1993). Constructivist values for instructional systems design: Five principles toward a new mindset. Educational Technology Research and Development, 41, 4-16.

[56] Lee, J. H. and Kim, M. H. (1999). Enhancing fuzzy set model for high quality document rankings. *Proceedings of the 19th Euromicro Conference*. Paris. Pp. 337-340.

[57] Leslie Johnston (2005). Development and assessment of a public discovery and delivery interface for a Fedora a repository. *D-Lib Magazine 11 (10)* (2005): 1-13.

[58] Levy , Pierre (2003). Cibercultura na rede. In: MORAES, Denis de. (org). Por uma Outra Comunicacao: media, mundializacao, cultura e poder. Rio de Janeiro: Record.

[59] Levy D. M. (1994). Fixed or fluid? Document stability and new media. *In Proceedings of the 1994 ACM European Conference on Hypermedia Technology*, pages 24-31.

[60] Levy D. M. (1997). I read the news today, oh boy: reading and attention in digital libraries. *In Proceedings of the 2nd ACM International Conference on Digital Libraries*, pages 202-211.

[61] M. A. Hearst (1996). The changing social roles of documents. Research in Support of Digital Libraries at Xerox PARC, part I. D-Lib Magazine, May 1996. http://www.dlib.org/dlib/may96/05hearst.html.

[62] M. A. Hearst, G. Kopec, and D. Brostky (1996). Paper and digital documents. Research in Support of Digital Libraries at Xerox PARC, part II. D-Lib Magazine, june 1996. http://www.dlib.org/dlib/june96/hearst/06hearst.html.

[63] Marchionini, G. (2000). Evaluation Digital Libraries: A longitudinal and multifaceted view. *Library Trends, 49*, 304-333.

[64] Marchionini, G., Plaisant, C., & Komlodi, A. (2003). The people in digital libraries: Multifaceted approaches to assessing needs and impact. In A. P. Bishop, B. Buttenfield & V. H. N. (Eds.), Digital library use: social practice in design and evaluation. Cambridge: The MIT Press.

[65] Marshal, C. C., Price, M. N., Golovchinsky, G., & Schilit, B. N. (1999). Introducing a digital library reading appliance into a reading group. *In Proceedings of ACM DL'99*, pp. 77-84.

[66] McCown, F., Bollen, J., & Nelson, M. L. (2005). Evaluation of the NSDL and Google for obtaining pedagogical resources. *In Proceedings of the ECDL 2005.* Lecture notes in computer science 3652 (pp. 344-355).

[67] Michael G. Christel, David B. Winkler, C. Roy Taylor (1997). Multimedia abstractions for a digital video library. *In Proceedings of ACM Digital Libraries'97 Conference*, Philadephia, PA, pp.21-29.

[68] Michal Kosiedowski, Cezary Mazurek, Maciej Stroinski, Marcin Werla, Marcin Wolski (2007). Federating digital library services for advanced applications in science and education. *Computational Methods in Science and Technology* 13(2), 101-112 (2007).

[69] Monopoli, M., Nicholas, D., Georgiou, P., & Korfiati, M. (2002). A user-oriented evaluation of digital libraries: Case study: The "electronic journals" service of the library and information service of the University of Patras, Greece. Aslib Proceedings, 54 (2), 103-117.

[70] Nelson, J., Hayes, J. R. (1988). How the writing context shapes college students' strategies for writing from source. Technical Report no. 16. Center for the study of writing. Berkeley, CA: University of California.

[71] Nicole Compbell (2001). Usability Assessment of Library-Related Web Sites: Methods and Case Studies. American Library Association. Chicago, Illinois, 2001 p.125.

[72] Nielsen, J. (1993). Usability Engineering. San Diego, CA: Academic Press.

[73] Norman, Donald A., Draper, Stephen W. (1986). Cognitive Engineering. User-Centered-System Design: new perspective on Human-Computer-Interation. New Jersey.

[74] O'Hara, K. O., Smith, F., Newman, W., & Sellen, A. (1998). Student readers' use of library documents: implications for library technologies. *In Proceedings of CHI'*98, pp. 233-240.

[75] Pamela Gore & Sandra Hirsh (2003). Planning your way to a more usable Web site. *Online (Weston, Conn)* 27 (3) (2003): 20-2 – 24-7.

[76] Plass, J. L., & Homer, B. D. (2002). Cognitive load in multimedia learning: The role of learner preferences and abilities. Paper accepted for presentation at the International Conference on Computers in Education (ICCE) in Auckland, New Zealand.

[77] R. Kengeri, C. D. Seals, H. P. Reddy, H. D. Harley, and E. A. Fox (1997). Usability study of digital libraries: ACM, IEEE-CS, NCSTRL, NDLTD, December 1997. http://fox.cs.vt.edu/~fox/u/Usability.pdf. (9 June 2009).

[78] Scott Steven, DEAN Zollman, Michal Christel, Brian Adrian (2007). Virtual Pedagogical Agents as Aids for High School Physics Teachers. ICL Conference, September 26-28, 2007 Villach, Austria.

[79] Shneiderman, B. (1998). Designing the user interface strategies for effective human-computer interaction (3rd ed). Reading, MA: Addision-Wesley.

[80] Smith, T., Janee, G., Frew, J., & Coleman, A. (2001). The Alexandria Digital Earth Prototype system. In E. Fox & C. Borgman (Eds.), *Proceedings of the First ACM*

+ *IEEE Joint Conference on Digital Libraries* (pp. 118-119). New York: ACM Press.

[81] Snyder, I. (1998). Beyond the hype: reassessing hypertext. In I. Snyder (Ed.), Page to screen: Taking literacy in the electronic era. London/New York: Routledge.

[82] Song, C. R. (2002). Literature review for hypermedia study from an individual learning perspective. *British Journal of Education Technology, 33(4)*, 435-447.

[83] Susan M. Ryan (2003). Library Web site administration: A strategic planning model for the small academic library. *The Journal of Academic Librarianship 29* (4) (2003): 207-218.

[84] Susan Thompson (2003). Remote observation strategies for usability testing. *Information Technology and Libraries 22* (1) (2003, March): 22-32.

[85] Sushan Dhakal (2007). Open digital library, implementation in open educational perspective. *Kathmandu University Journal of Science, Engineering and Technology*, Vol. I, No. III, Journal, 2007.

[86] Tague-Sutcliffe, J. (1992). The pragmatics of information retrieval experimentation, revisited. *Information Processing and Management*, 88(4), 467-490.

[87] Tane, J., C. Schmit, G. Stumme. S. Staab & R. Studer (2003). The Courseware Watchdog: an Ontology-based tool for finding and organizing learning material. In Fachtagung Mobiles Lernen and Forschen.

[88] Teal Anderson and Sayeed Choudhury (2008). A Usability Research Agenda for Digital Libraries (Baltimore, Maryland: The Digital Knowledge Center Sheridan Libraries, John Hopkins University. http://dkc.jhu.edu/~teal/usability_research_agenda.html. 13 August 2008).

[89] Theng, Y. L., Mohd-Nasir, N., Buchanan, G., Fields, B., & Thimbleby, H. (2001). Dynamic digital libraries for children. In E. Fox & C. Borgman (Eds.),

Proceedings of ACM/IEEE Joint Conference on Digital Libraries (pp. 406-415). Roanoke, VA: ACM Press.

[90] Twidale, M. B. et al. (2007). Writing in the library: Exploring tighter integration of digital library use with the writing process, *Information Processing and Management* (2007), doi:10.1016/j.imp.2007.05.010.

[91] Van House, N. A., Butler, M. H., Ogle, V., & Schiff, L. (1996, February). User-Centered iterative design for digital libraries: the Cypress experience. D-Lib Magazine, 2, Retrieval February 3, 2009, from http://www.dlib.org/dlib/february96/02vanhouse.html.

[92] Vergara, M. N. Capuano & E. Sangineto (2003). Diogene: a Training Web Broker for ITC Professionals, in 2nd Int. Conference on Multimedia and ICT in Education (m-ICTE 2003) Badajoz, Spain, 330-4.

[93] Windschitl, M. (1998). The WWW and classroom research: what path do we take? *Educational Researcher*, 27(1), 28-33.

[94] Windschitl, M. (2000). Using the WWW for teaching and learning in k-12 classrooms: what are the interesting research questions? *cyberPsychology & Behavior*, 3 (1), 89-96.

[95] Wong, K. L., Lam, W., & Yen, J. (1999). Interactive Chinese news event detection and tracking. *In Proceedings of the 2nd Asian Digital Library Workshop*. (pp. 30-46). Taipei, Taiwan.

[96] Wu, S. and Witten, I. H. (2006). Towards a digital library for language learning. Proc European Conf. on Digital Libraries. Pp. 341-352, Alicante. Spain.

[97] Xie, H. I. (2008). Users' evaluation of digital libraries (DLs): Their uses, ---, *Information Processing and Management* (2008), doi:10.1016/j.imp.2007.10.003.

[98] Yang, S. C. (2001). An interpretive and situated approach to an evaluation of Perseus digital libraries. *Journal of the American Society for Information Science and Technology*, 52, 1210-1223.

[99] Bishop, A. P. (1999). Making digital libraries go: comparing use across genres. *In Proceedings of ACMDL*'99 pp. 94-103.

CHAPTER 3

CONCEPTUAL FRAMEWORK

SECTION 1

INFORMATION RETRIEVAL (IR)

3.1.1) MULTIMEDIA INFORMATION RETRIEVAL (MIR) AND COMMUNICATION

Yu (2004)[75] indicated that the research on Information Retrieval started in 1960s and initially focused on textual document retrieval. Now it has become a very wide research field that studies the representation, storage, organization, and access to various information items (e.g. documents, image, video, audio etc.). Hence, it has been named Multimedia Information Retrieval (MIR). Smeulders et al. (2000)[60] denoted the primary goal of MIR, to retrieve relevant information items in response to user queries, while returning as few irrelevant ones as possible. One example is content-based image retrieval (CBIR). In fact, the term MIR is not limited to the retrieval of information. It covers a wide range of topics in information processing which are related to information retrieval including information translation, summarization and classification as well. DUC A. Tran (1996)[17] discussed that proliferation of Internet, the needs and methods for accessing and sharing information have reached a new height. Users have become more demanding with interests not only in traditional alphanumerical contents but also in multimedia contents. Requests for the richer data have amplified in parallel with the emergence of many important applications including digital libraries, distance learning, public information systems, e-commerce, movie on demand, and other corporate communications. Many of these applications allow the user to watch or listen to the stream of data as it arrives. Overlapping the layout of the data at the receiver with the transmission by the sender is referred to as multimedia streaming. ChengFu Chou (2002)[10] indicated that technological advances in digital signal processing, data compression techniques, and high speed communication networks have made multimedia applications (such as large-scale continuous media servers) and wide-area upload applications (such as distance education over Internet) an active research area. Rao et al. (2008)[29] discussed that a new infrastructure of digital audio, image and video recorders and players, online services, electronic commerce and education is rapidly being deployed. Digital media offers several distinct advantages over analog media. The quality of digital audio, image and video signals is higher than that of their analog computers. Editing is easy because one can access the exact discrete locations that need to be changed. Copying is simple with no loss of fidelity. A copy of digital media is identical to the original. Digital audio, image and video are easily transmitted across networked information systems. These advantages have opened up many new possibilities. Multimedia consists of Multimedia data set of interactions. Multimedia data is informally considered as the collection of three Ms: multi-source, multi-type and multi-format data. The interactions among the multimedia components consist of complex relationships without which multimedia would be a simple set of visual, audio and other data. Multimedia and multimedia communication can be globally viewed as a hierarchical system. The multimedia software and applications provide a direct interactive environment for users. When a computer requires information from remote computers or servers, multimedia information must travel through computer networks. Because the amount of information involved in the transmission of video and audio can be substantial, the multimedia information must be compressed before it can be sent through the network in order to reduce the communication delay. Constraints, such as limited delay and jitter, are used to ensure a reasonable video and audio effect at the receiving end. Therefore, communication networks are undergoing constant improvements in order to provide for multimedia communication capabilities. LANs are used to connect local computers and other equipment and Wide Area Networks (WANs) and the Internet connects the LANs together. Better standards are constantly being developed, in order to provide a global information superhighway across which multimedia information will travel. Multimedia communication is the field referring to the representation, storage, retrieval and dissemination of machine-processable information expressed in multiple media, such as text, image, graphics, speech, audio, video, animation, handwriting and data files. Multimedia best suits the human being's complex perception and communicating behavior, as well as the way of acting. Namely, it does not only provide communication capabilities and information sharing for people, irrespective of location and time, but it also provides easy and immediate access to widely distributed information banks and information processing centers. Applications in medicine, education, travel, real estate, banking, insurance, administration and publishing are emerging at a fast pace. These applications are characterized by large multimedia documents that must be communicated within very short delays. Computer-controlled cooperative work, whereby a group of users can jointly view, create, edit and discuss multimedia documents, is going to be characteristic of many transactions. Some glamorous applications in multimedia processing include distance learning, virtual library access and living books. In distance learning, students learn and interact with instructors remotely across a broadband communication network. Virtual library access means that they instantly have access to all of the published material in the world, in its original form and format, and that they can browse, display, print and even modify the material instantaneously. Living books supplement the written word and the associated pictures with animations, and hyperlinks provide access to supplementary material. Applications that are enabled or enhanced by video are often seen as the primary justification for the development of multimedia networks.

3.1.1.1) MULTIMEDIA COMMUNICATION MODEL

(Roa et al., 2008)[29] described multimedia communication model in the following words:

> "A multimedia communication model is strongly influenced by the manufacture-dependent solutions for PCs, and workstations, including application software on the one hand and the intelligent network concept on the other." (p.30)

A layered model for future multimedia communication comprises five components, which are as follow:

- Partitioning of complex information objects into distinct information types for the purpose of easier communicating, storing and processing. This comprises data, video or audio and takes into account the integration of different information types.
- Standardization of service components per information type, possibly with several levels of quality per information type.
- Creation of platform as two levels: a network service platform and a multimedia communication platform.
- Definition of generic applications for multiple use in various multimedia environments and different branches meeting common widespread needs.
- Specific applications.

3.1.1.2) ELEMENTS OF MULTIMEDIA SYSTEMS

Multimedia systems generally use two key communications modes: person-to-person communications and person-to-machine communications. Figure (3.1.1.2) presents key elements of multimedia systems.

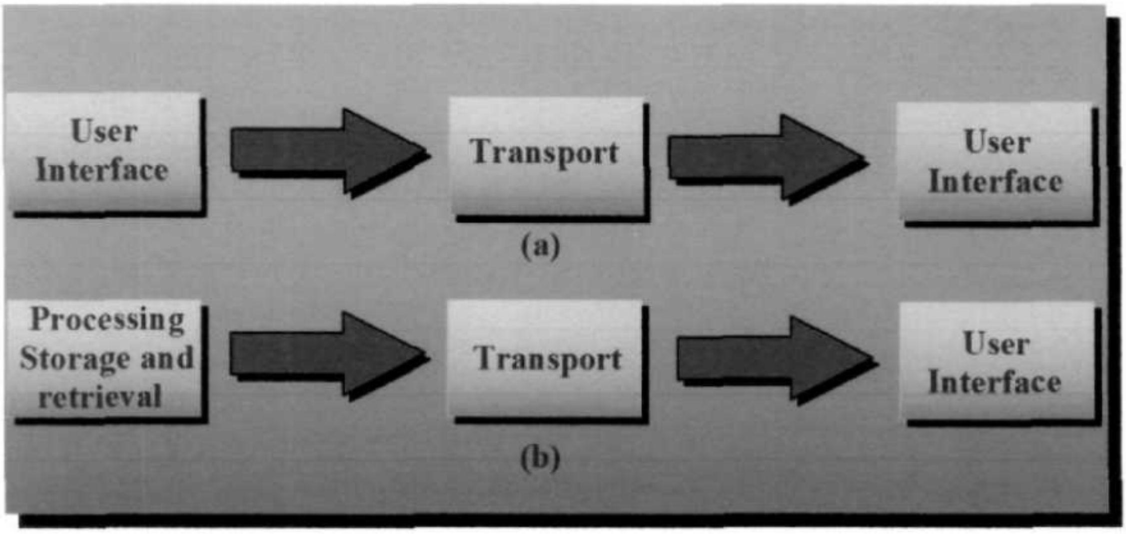

Figure (3.1.1.2): presents of multimedia systems used in (a) person-to-person communications and (b) person-to-machine communications according to Rao et al. (2008)[29]

3.1.1.2.1) In the person-to-person mode shown in Figure 3.1.1.2 (a), there is a user interface that provides the mechanisms for all users to interact with each other, and there is a transport layer that moves the multimedia signals from one user location to some or all other user locations associated with the communications. The user interface creates the multimedia signal and allows users to interact with the multimedia signal in easy-to-use manner. The transport layer preserves the quality of the multimedia signals so that all users receive what they perceive to be high-quality signals at each user location. Examples of applications for the person-to-person mode are teleconferencing, videophones, distance learning and shared workspace scenarios.

3.1.1.2.2) In the person-to-machine mode, shown in Figure 3.1.1.2 (b), there is again a user interface for interacting with the machine, along with a transport layer for moving the multimedia signal from the storage location to the user. Some mechanism for storage and retrieval of multimedia signals are either created by the user or requested by the user. The storage and retrieval mechanisms involve browsing and searching to find existing multimedia data. In addition, these mechanisms involve storage and archiving in order to move user-created multimedia data to the appropriate place for access by others. Examples of applications for person-to-machine mode include creation and access of business meeting notes, access of broadcast video and document archives from a digital library or other repositories.

3.1.1.3) MEDIA INTERACTION

Media interaction is shown in Figure (3.1.1.3). As can be seen, media are categorized into three major classes. The first is textual information, the second is an audio, including speech and music, and third represents image and video. The goal of speech recognition is to transcribe spoken inputs literally into individual words, but the goal of spoken language understanding research is to extract meaning from whatever was recognized.

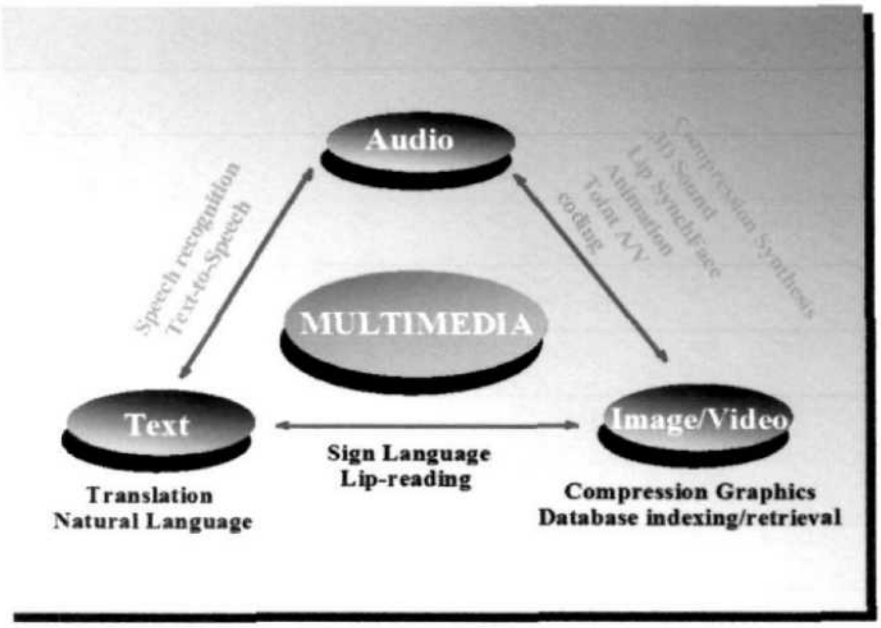

Figure (3.1.1.3): Media Interaction [2.1]. © 1990 IEEE (cited in Rao et al., 2008[29])

3.1.2) INFORMATION RETRIEVAL (IR) & DOCUMENTATION

Maristella Agosti (2007)[39] referred to the term information retrieval which identifies that a person – the user – has to conduct to choose from a collection of documents, those that can be of interest to him to satisfy a specific and contingent information used. It allows that the aim of the area of information retrieval is to help and support the user in choosing, among the available documents, those that, with higher probability are more suitable to satisfy his information need. Figure (3.1.2.1) sketches the situation: the user has the possibility of choosing the documents of his interest from an available collection, but he needs to have a tool that can help him in choosing the subset of documents, which are of his interest without needing to invest a lot of time inspecting all the document of the collection. Figure (3.1.2.1) also shows the three main actors and aspects that information retrieval needs to address:

- User,
- Collection of documents,
- Retrieval, which means a function or model used in retrieval and accessing information .

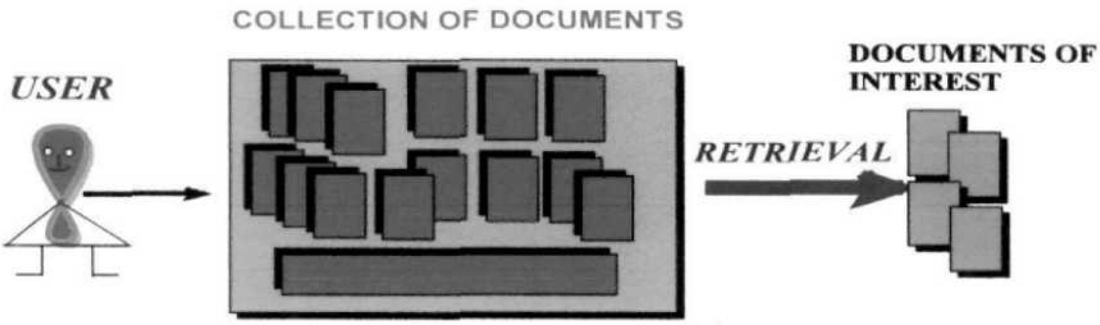

Figure (3.1.2.1): Information Retrieval Aim according to A. Maristella (2007)[39]

Doyle, L. B. (1975)[16] and Salton, G. (1963)[53] indicated that the study of hypertext methods was at the basis of a new sort of network-based and associative information retrieval entitled EXPLICIT. Associative information retrieval methods are those retrieval methods that have been proposed and experimented since the early days of information retrieval. The EXPLICIT model was based on a two-level architecture initially proposed in the hypertext as an effective information retrieval tool for the final user that introduced by Agosti et al. (1989)[2] and refined in an approach for the conceptual modeling of IR auxiliary data introduced by Agosti et al. (1990)[3]. The two-level architecture holds the two main parts of the information resource managed by an information retrieval tool. On the one hand the collections of content objects (e.g. a single collection of documents, different collection of different types of digital content objects). Moreover, on the other the term structure, which is a scheme of concepts that can be composed of either one single indexing structure or some cooperative content representation structures such as those depicted in Figure (3.1.2.2) in a sort of "semantic network".

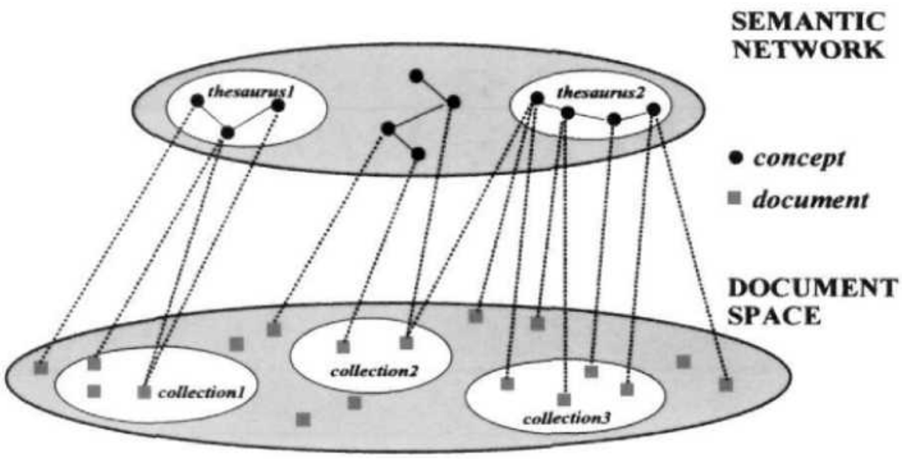

Figure (3.1.2.2): the EXPLICIT architecture and model according to Agosti et al. (1990)[3]

The system manages this network to retrieve information of use for the final user, but also to present the representation of the contents of the collections to the user, who can use them for browsing and becoming acquainted with the information richness of the managed collections. Multimedia retrieval is the other relevant area that researchers started to face in a systematic way and for different media during the decade. The complexity of the management of collections of multimedia digital documents can be faced in particular for information retrieval purposes, but also from a general architectural point of view, that is, the area of digital libraries and digital library systems. The IMS (Information Multimedia System) research group is participating in the search in Audio-visual content using Peer-to-Peer (P2P) information retrieval (SAPIR) project (http:// www.sapir.eul). Fabio Crestani[13] discussed that information retrieval techniques have been used for a long time to identify links between textual items for automatic construction of hypertexts and electronic books where sought information can be accessed by browsing. Information retrieval (IR) has been created with the purpose of the enabling a user to access information relevant to the user information need expressed in a query, where the information is contained in large archives of textual data. The term "information retrieval" is described as "searching and retrieval of information from storage according to specific subject." The word retrieval means to discover and bring to the notice of the users, the documents in which information is embedded. Vickery (1970)[69] described the word retrieval as "retrieval is essential concerned with the structure of the operation of the device to select documentary information from the store of information in response to several questions". Salton (1979)[54] and Salton and Fox (1985)[55] defined an information retrieval system as a "system used to store items of information that need to be processed, searched, retrieved, and disseminated to various user population". Nowadays multimedia indexing and retrieval techniques are being developed to access image, video, and sound database without text descriptions. Any information retrieval system is based on some theory such as classification theory, linguistic theories in the context of automatic indexing, psychological approaches and early structural models of Fairthone[21] and others (Fairthrone, 1961[21]). Therefore, the different models of information retrieval systems are as follows: Models Based on Input and Output such as Data Retrieval Model, Information Retrieval Model, and Knowledge Retrieval Model. Models Based on Theories and Tools such as Linguistic Models (Ponte & Croft, 1998[48]), Mathematical Models, Psychological Model Brooks, 1968[7]; Oddy, 1977[46]). Moreover, the Economic Model, User Model in Information Retrieval, Logical Models, Vector Processing Models, Vector Space Model (Salton, Yang & Wong,1975[56]), Probabilistic Models (Fuhr, 1992[23]; Robertson, 1977[50]), Cognitive Models (Ingwersen, 1992[26]), the Fuzzy Set Model (Radecki, 1979[49]; Lee, 1999[35]), Cluster Model (Ellis, 1990[20]; Sowa, 2000[61]; Deewester, Dumais, Furnas, Landauer, & Harshman, 1990[14]). Oard & Dorr (1996)[45] defined that an information retrieval is a process by which users seek to locate documents that contain information about the subject of their query. The information retrieval process is distinguished from the conventional database access paradigm by the user's desire to find documents about a subject rather than data that directly answers the query. Lancaster (1968)[33] defined that an information retrieval system does not inform (i.e. change the knowledge of) the user on the subject of his inquiry but it merely informs on the existence (or nonexistence) and whereabouts of documents rating to this request. Figure (3.1.2.3) depicts a typical information retrieval system.

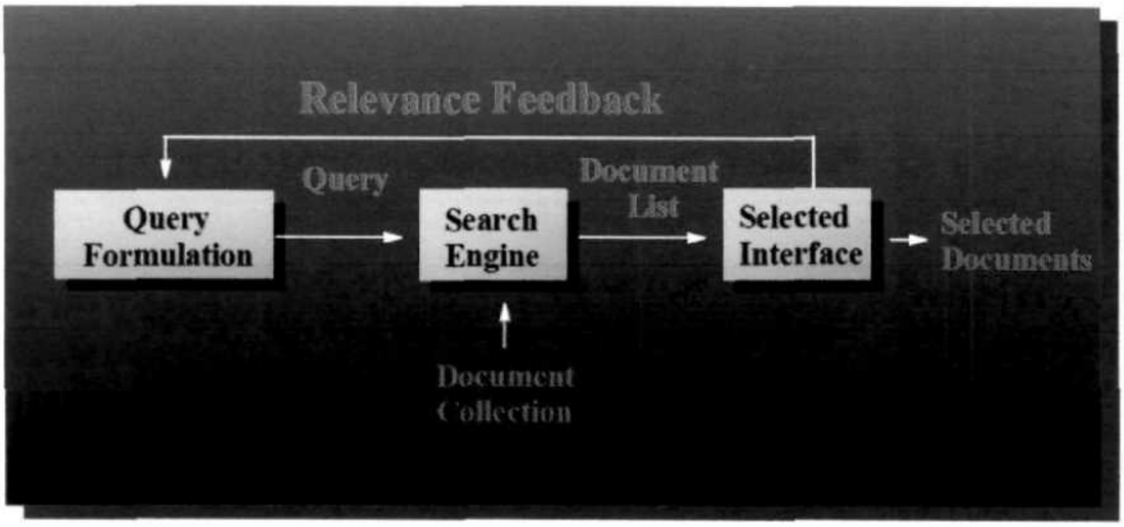

Figure (3.1.2.3): A typical information retrieval system according to Oard & Dorr (1996)[45]

With the advanced of technologies in World Wide Web and digital libraries, the traditional discipline of information retrieval has been extended to multimedia including image, graphics, video, and speech, and multi-languages, including European, Asian and other languages. Users expect to submit a textual query to the digital library in one language and obtain all the relevant information in all media and languages. For example, the following are some scenarios of the application CLIR in digital libraries (Cross-Language Information Retrieval):

1. The digital library has a collection of monolingual documents but it supports users who speak different languages. In this case, the queries may be of different languages. The queries must be translated into document languages before retrieval.
2. The digital library has a collection of parallel documents. Users who know only own language may search in the digital library using his language and

obtain the relevant documents in the same language. The corresponding documents in other languages that are parallel to retrieved documents are also extracted. In this case, the digital library must be able to align the parallel documents if the documents do not come in pairs from the source.

3. The digital library has a collection of multi-lingual documents. Multiple languages may exist in individual document.

Cross-lingual information retrieval refers to the ability to process a query for information in one language, search a collection of objects, including text, images, audio files, etc. and return the most relevant objects, translated into the user's language of necessary (Klavans et al., 1999[31]; Oard & Dorr, 1996[45]). An information retrieval model has two major components, (i) representation of queries and documents, and (ii) comparisons of these representations. The objectives of an information retrieval system are to automate the process of examining documents by computing the comparisons between the representations of queries and documents (Turtle & Croft, 1991[66]; Van Rijsbergen, 1979[67]). See Figure (3.1.2.4) below that depicts the representation and comparison processes in an information retrieval model.

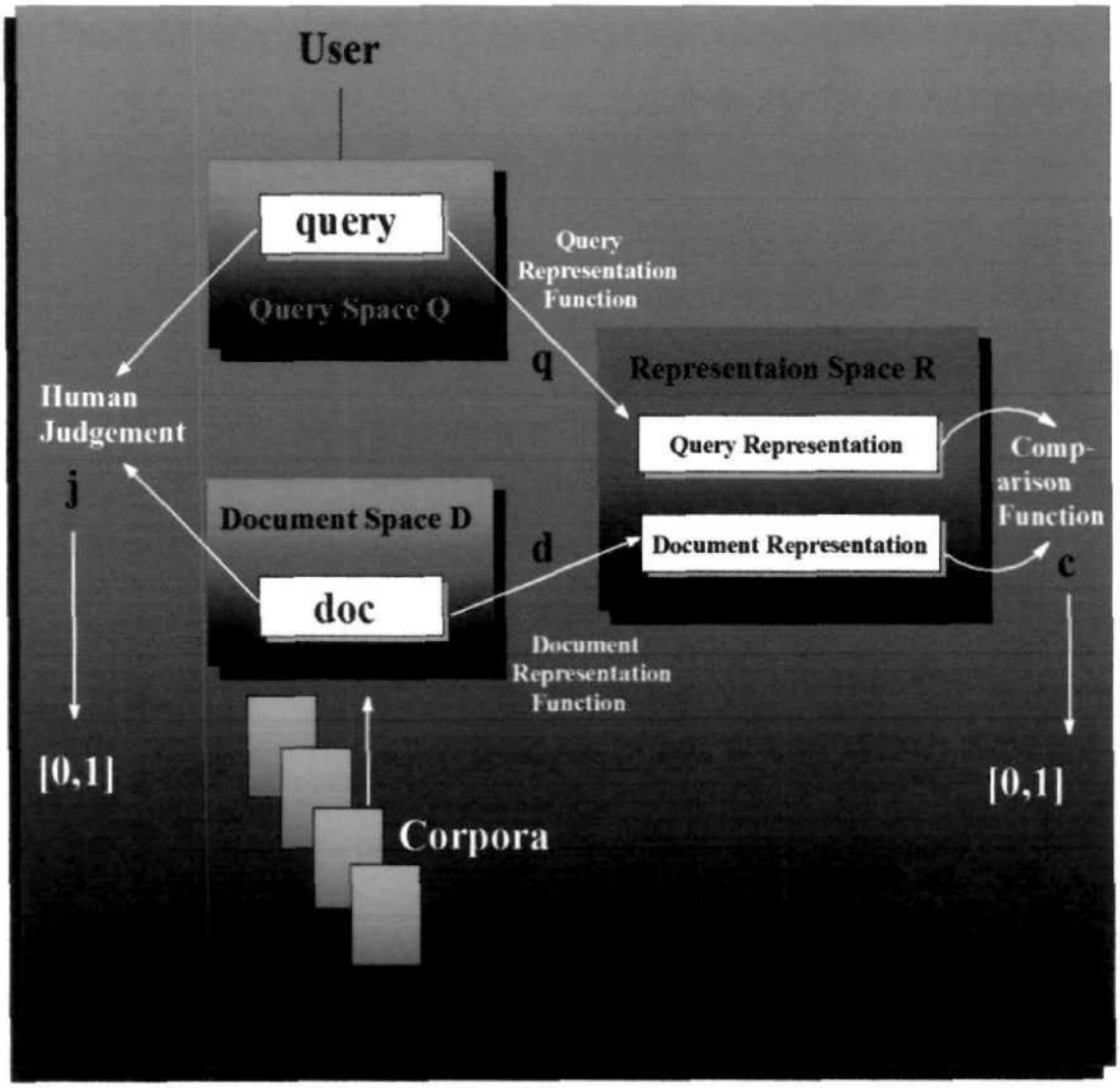

Figure (3.1.2.4): Representation and comparison processes in an information retrieval model (Yang & Li, 2005[72])

3.1.3) CONTENT-BASED IMAGE RETRIEVAL (CBIR)

Nowadays, the needs of electronic imaging are growing rapidly. The digital libraries are adding up visual data such as photographs, videos, motion pictures, maps, manuscripts, satellite pictures and other special forms of data. Images of these materials are a significant component of digital libraries for the most demanding in terms of conversion, storage and retrieval (B. P. Prakash, 1996[5]). Recent years have witeness a rapid increase of the volume of digital retrieval. Early research of image retrieval is searching by manually annotating every image in a database. However, these text-based techniques are impractical for two reasons: large size of image databases and subjective meanings of images (Wu et al., 2000[71]). To avoid manual annotating, an alternative approach is content-based image retrieval (CBIR), which automatically retrieves images of user interest from large image databases based on the visual contents such as color, texture, shape, etc. It has been an active and fast advancing research area since the 1990s (Smeulders et al., 2000[60]). The task of image retrieval is to find as many as possible "similar" images to the query images in a given database. The retrieval system acts as a classifier to divide the images in the database into two classes, either relevant or irrelevant. Many supervised learning approaches have been employed to approach this classification problem. Successful examples of learning approaches in content-based image retrieval can be found in the literature (Tieu and Viola, 2000[64]; Cox et al., 2000[11]; Tian et al., 2000[63]; Rui et al., 1999[52]; Vasconcels & Lippman, 2000[68]; Tong and Chang, 2001[65]; Yang, 2003[73]; Laakaonen, 1999[32]). Furthermore, concept-based image retrieval has been proposed, which is a combination of text-based image retrieval and content-based image retrieval. To overcome the limitations of text-based image retrieval, content-based image retrieval (CBIR) systems emerged in the early 1990s (Kato, 1982[30]; Faloutsos et al., 1994[22]). In CBIR, features directly derived from their visual content by using image-processing techniques automatically or semi-automatically indexed the images. The common functionalities in CBIR can be summarized as follows (Smeulder et al., 2000; Rui et al., 1999[52]; Antani, Kasturi and Jain, 2002[4]; Yoshitaka and Ichikawa, 1999[74]):

- Image processing and pattern recognition techniques are used to extract low-level features, such as color, texture, shape, etc. from image.
- For a given feature, a representation of the feature in a vector form and a notion of similarity are determined, and image is represented as a collection of features.
- Finally, image retrievals are performed on computing similarity in feature spaces and results are ranked based on the similarity values computed.

Eakins John (2002)[18] identified three distinct levels of abstraction of search requirement with increasing complexity. Level1 comprises retrieval by primitive features such as color, texture, shape or the spatial location of image elements. At level2, some degree of object and scene recognition as well as inference about the image content is required. Queries at this level may contain specific objects and scenes. Level3 comprises retrieval by abstract attributes, involving a significant amount of high-level reasoning about the meaning and purpose of the objects or scenes depicted. This includes retrieval of named events of pictures with emotional or religious significance, etc. Searches in CBIR can also be distinguished into three major categories (Cox et al., 1996[12]): target search category-specific search and open-ended search or browsing. The ten-level visual structure presented according to Jaime and Chang (2000)[28] that provides an elaborate and systematic way of abstracting images based on syntax and semantics. Syntax refers to the way visual elements are arranged without considering the meaning of such arrangements (e.g., color, texture, etc.). Semantics, on the other hand, deals with the meaning of those elements and of their arrangements (e.g., objects, events, etc.).

1. Color is the most widely used feature in CBIR, since it is an important dimension of human visual perception and it is invariant with respect to image scaling, translation and rotation and above all it is computationally least intensive (Rui et al., 1999[52]; Del Bimbo, 1999[15]).
2. Texture, although there is no strict definition of the image texture, it is easily perceived by human and is believed to be a rich source of visual information. The existing texture descriptors are classified based on three different approaches as statistical, Model-based and Transform-based (Haralick, 1979[24]; Tamura, Mori, and Yamawaki, 1978[62]; Picard and Minka[47]; Manjunath and Ma, 1996[37]). The texture descriptor in MPEG-7 facilitates browsing and similarity retrieval in image and video databases. There are tree texture descriptors as homogeneous texture, edge histogram, and texture browsing (ISO/IEC JTC1, 2000[27]).
3. Shape, in many situations, people can recognize an object only by its shape and it is probably the most important properly that is perceived about objects. Generally, there are groups of shapes descriptors (Mehrotra and Gary, 1995[44]): boundary or contour-based shape descriptors and region based shape descriptors. Boundary representations emphasize the closed curve that surrounds the shape. This curve has been described by numerous models, including chain codes, polygons, circular arcs, splines, explicit and implicit polynomials, and boundary Fourier descriptors. Region bases shape descriptor on the other hand, emphasizes the material within the closed boundary or based on the entire shape region.

Image retrieval based on multi-modal information sources has been recently gaining popularity due the huge amount of multi-modal information available on the Web (i.e., images with collateral texts in image captions, headers, titles and other places in HTML OR XML documents) (Chen, 2006[8]; Santini, 2002[57]; Westerveld, 2000[70]; Chen et al., 2001[9]; Lu et al., 2003[36]; Sclaroff et al., 1999[58]; Rong and William, 2002[51]). There are two main combination techniques currently investigated (Chen, 2006[8]): the text and image modalities are sequentially used; and the text and image modalities are simultaneously used, combined either linearly or nonlinearly.

3.1.4) HYPERTEXT AND HYPERMEDIA CONCEPTUALIZATION

Hypertext may simply be defined, as an electronic system to manage a collection of information that can be accessed none sequentially. It consists of nodes or 'chunks' of information and logical links between them. The variety of nodes and links that can be defined make hypertext a very flexible structure in which information is provided both by what is stored in each node and by the way these nodes are linked to each other. The importance of hypertext systems lies in their potential capacity to augment and amplify human intellect (Marchionini & Shneidrman, 1988[38]). Hypertext with its powerful, interactive nodes and associated information retrieval capabilities offers greater potential and flexibilities in the ways of presenting teaching materials. It offers great many possibilities for teaching and learning to both the teacher and the taught. The hypertext-based system not only presents information on a topic but also encourages thinking analytically and critically about the information from multiple perspectives. It further enables the learners to participate in the learning/teaching program actively. Another positive contribution of hypertext-based system is to enable the student to develop authoring skills and add his/her views as notes, new thoughts, arguments, comments etc. Findings of several students have provided evidence of the potential of hypertext-based learning systems. For example, a study at Broun University found that the students were image modalities are sequentially used; and the text and image modalities are simultaneously used, combined either linearly or nonlinearly.

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The two-level EXPLICIT model is one of the conceptual models, which is based on two types of entity: data and auxiliary data. Data are the elementary objects of interest of the final user. Data are indexed and retrieved, and can consist of multimedia documents or fragments. Auxiliary data are the objects, which describe the semantic content of data. Thus the main elements of the EXPLICIT model are nodes and links, where links are used to express semantic relations between data and auxiliary data nodes. There are four different types of links: PT, TP, PP, and TT. PT and TP links represent relations between a page and terms and a term and pages respectively. A page is linked to terms describing the page content. PP links relate a page to other pages. Structural PP links, such as "next", "previous" or "go to the Table Contents" links are easily detectable. Finally, TT links are relate a term to other terms. The Hypertext Books project was carried out during 1997-2002 at the University of Padua. The objective of the project was to develop a methodology to enhance the paper-based version of a text book by the automatic insertion of semantic links. Effectively the Hypertext Book project aimed to developing a tool for the automatic construction of hyper-textbooks from text books (Landoni, M., 1997[34]). In particular, the book pages are the unit for reference for their hyper-textbook. The user can browse the book sequentially, going from one page to the next or to the previous one. The relevance relationships from Subject Index terms to pages have to be preserved because the Subject Index is the set of terms the author used to index the textbook, and therefore is the most important structure for browsing. The Table of Contents has to be presented and augmented, since it is one of the most used features of the paper textbook (Egan et al., 1989[19]). Digital annotations: it is a Formal Model and its application. Marshall, C. C., (1997)[40] studied personal annotative practices of American College students to point out the form the annotations have in the text books and function of the annotations, which is derived from their form. Marshall[40] (pp. 237-238) discovered that: First, annotations are procedural signals, cluing in the student to where an assignment starts, what material is important, and what material might require a second (or successive readings). Second, annotations are place-marks; they hold the quotes that are being reserved for the paper that the student will write at the end of the term, the chemical reactions and term definitions the student must memorize for the final, the theorem that is key to the proof in the homework assignment. Third, they are in situ way of working problems. Fourth, annotations record interpretive activity, either from another reader (e.g. a professors explanation), or as the result of careful reading (the student has interpreted him/or herself). Fifth, and most elusively, these markings act as a visible trace of a reader's attention, a focus on the passing words, and a marker of all that has already been read (as if these words are now processed). Finally, the markings may just be incidental reflecting the material circumstance of reading. Marshall, C. C., (1998)[41] carried on her research work and categorized annotations along several dimensions which reflect the form annotations may take on: formal versus informal annotations, explicit versus tacit annotations as writing versus annotations as reading, hyper-extensive versus intensive annotations, permanent versus transient annotations, published versus private annotations. Finally, Marshall (2002[42], 2004[43]), and Shipman et al. (2003)[59] investigated the relationship between private, shared and public annotations and how they can be exploited to find useful passages in the text. Recently, Hwang et al. (2007)[25] conducted a study on the impact of annotations in improving the learning achievements of students. Four-month experimentation was performed, where the learning achievements of student who did not use annotations and students who used a Web-based annotation system for learning material were compared. By using a questionnaire, they found that most of the students agree that the annotation system improved their online reading performances and was easy to use; furthermore, using the annotation system improved the interaction between learners and the provided materials, by increasing students' interest in learning; finally, students reported that the possibility of sharing annotations both between groups and publicly improved their motivation to learn.

REFERENCES

[1] Agosti, M., Crestani, F. (1993). A methodology for the automatic costruction of a hypertext for information retrieval. *In: Proceedings of the ACM Symposium on Applied Computing*, pp. 745-753. Indianapolis, USA.

[2] Agosti, M., Crestani, Fi Gradenigo, G., Maltiello, P. (1989). The hypertext as an effective information retrieval tool for the final user. In A. A. Martino (ed.) *Preproceedings of the 3rd International Conference on Logics, Informatics and Law*, Vol. I, pp. 1-19.

[3] Agosti, M., Crestani, Fi Gradenigo, G., Maltiello, P. (1990). An approach for the conceptual modeling of IR auxiliary data. *In 9th Annual IEEE International Conference on Computers and Communications*, pp. 500-505. Scottsdale, Arizona.

[4] Antani, S., Kasturi, R. and Jain, R. (2002). A survey on the use of pattern recognition methods for abstraction, indexing and retrieval of images and video, *Pattern Recognition 35 (4)*: 945-965.

[5] B. P. Prakash. (1996). Digital imaging: Technology, *trends and impact on libraries, SIS-96*, 18-20, Jan. '96, Bangalore.

[6] Beeman, W. O. et al, (1987). Intermedia – a case study of innovation in higher education, providence, RI. Brown University.

[7] Brooks, B. C. (1968). The derivation and application of the Bradford_zipfDistribution. *Journal of Documentation*. 24, 247-265.

[8] Chen, N. (2006). A survey of indexing and retrieval of multimodal documents: text and image, technical report, 2006-505, Queen's University.

[9] Chen, Z., Liu, W. Y., Zhang, F., Li, M. J. and Zhang (2001). Web mining for web image retrieval. *Journal of American Society for Information Science and Technology, 52 (10)*: 831-839. 2001.

[10] ChengFu Chou. (2002). Scalable design of wide-area upload applications and distributed continuous media systems, Dissertation. UMI No. 3055558.

[11] Cox, I. J., Miller, M. L., Minka, T. P., and Papsthomas, T. V. (2000). The Bayesian image retrieval system, PicHunter: theory, implementation, and psychophysical experience. IEEE Trans. *Image Processing*, Vol. 9, No. 1, pp. 20-37.

[12] Cox, I. J., Miller, M. L., Omohundro, S. M. and Yianilos, P. N. (1996). Target testing and the PicHunter Bayesian multimedia retrieval system, *Proceedings of 3rd of Forum on Research and Technology Advances in Digital Libraries* (ADL96), Washington DC, USA, pp. 66-75.

[13] Crestani Fabio. From linking text to linking crimes: Information retrieval, but not as you know it. In Croft W. B. (2008). *Information Access Through Search Engines and Digital Libraries* (Eds.), Springer.

[14] Deewester, S., Dumais, S. T., Furnas, G. W., Landaure, T. K., & Harshman, R, (1990). Indexing by latent semantic analysis. *Journal of the American Society for Information Science, 41 (6)*, 391-407.

[15] Del Bimbo A. (1999). *Visual Information Retrieval*, Morgan Kaufmann Publishers, San Francisco, Calif.

[16] Doyle, L. B. (1975). Information retrieval and processing. Melville, Los Angeles.

[17] DUCA Tran. (1996). Overlay multicast solutions to media streaming, dissertation, B.S. Vitnam National University, Hanoi, Vietnam UMI.

[18] Eakins John, P. (2002). Towards Intelligent image retrieval, Pattern Recognition 35: 3-14.

[19] Egan, D., Remde, J., Gomez, L., Landauer, T., Eberhardt, J., Lochbaum, C. (1989). Formative design – evaluation of superbook. *ACM Transactions on Information Systems 7 (1)*, 30-57.

[20] Ellis, Davis (1990). New Horizons in information retrieval. Association publishing house ltd.

[21] Fairthone, R. A. (1961). The Mathematics of classification towards information retrieval. London: Butter worth's. 1-10.

[22] Faloutsos, C., Barber, R., Flickner, M., Hanfner, J., Niblack, W., Petkovic, D. and Equitz, W. (1994). Efficient and effective querying by image content. *Journal of Intelligent Information System 3 (34)*: 231-262.

[23] Fuhr, N. (1992). Probabilistic models in information retrieval. *The Computer Journal, 35 (3)*, 243-255.

[24] Haralick, R. M. (1979). Statistical and structural approaches texture, *Proceedings of the IEEE*, Vol. 67 (5), pp. 786-804.

[25] Hwang, W. Y., Wang, C. Y., Sharples, M. (2007). A study of multimedia annotation of Web-based materials. *Computers and Education 48 (4)*, 680-699.

[26] Ingwersen, P. (1992). Information retrieval interaction. Taylor Graham, London.

[27] ISO/IEC JTC1/SC29/WG11/W3703 MPEG-7 (2000). Multimedia content description interface part3 visual.

[28] Jaime A. and Chang, S. F. (2000). A conceptual framework for indexing visual information at multiple levels, IS ◻ T/SPIE *Internet Imaging Vol. 3964*, San Jose, CA January,2000.

[29] K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic. (2008). Multimedia communication systems: Techniques, Standards, and Networks (3rd Ed.). Pearson Education, Inc. Pearson Prentice Hall.

[30] Kato, T. (1982). Database architecture for content-based image retrieval, in I., K. Sethi and R. J. Jain (eds.), *Image Storage and Retrieval Systems Proceedings of SPIE*, San Jose, CA, USA, Vol. 1662, pp. 112-123.

[31] Klavans, J., Hovy, E., Fluhr, C., Frederking, R. E., Oard, D., Okumura, A., Ishhikawa, K., & Sotoh, K. (1999). Multilingual (or cross-lingual) information retrieval. In Multilingual Information Management: Current Levels and Future Abilities (Ch.2). Pisa, Italy: Instituti Editoriali e Polografici Internazionali.

[32] Laakaonen, J., Koskela, M., and Oja, E. (1999). PicSOM: self-organizing maps for content-based image retrieval. *Proc. of IEEE Int'l Conf.* Neural Networks, Washington, DC, 1999.

[33] Lancaster, F. W. (1968). Information retrieval systems: Characteristics, testing and evaluation. New York: wiley.

[34] Landoni, M. (1997). The visual book system: a study of the use of the visual thetoric in the design of electronic books. Ph.D. Thesis, Department of Information Science, University of Strathclyde, Glasgow, Scotland, UK.

[35] Lee, J. (1999). Interactive learning with a Web-based digital library system. Prepared for the Ninth DELOS Workshop on Digital Libraries for Distance Learning. http://courses.cs.vt.edu/~cs3604/DELOS.html

[36] Lu, Y., Zhang, H., Liu, W. Y. and Hu. C. (2003). Joint semantics and feature based image retrieval using relevance feedback, *IEEE Transactions on Multimedia*, 5 (3): 339-347.

[37] Manjunath, B. S. and Ma, W. Y. (1996). Texture features for browsing and retrieval of image data, *IEEE Transactions on pattern Analysis and Machine Intelligence* 18 (19): 837-842.

[38] Marchionini, G. and Shneiderman, Ben. (1988). Finding facts Vs browsing knowledge in hypertext systems. *IEEE Computer*, January, pp. 70-79.

[39] Maristella Agosti. (2007). *Information Access Using the Guide of User Requirements*. Springer-Verlag Berlin Heidelberg. pp. 1-10.

[40] Marshall, C. C. (1997). Annotation from paper books to the digital library. In: R. B. Allen, E. Rasmussen (eds.) Proc. *2nd ACM Information Conference on Digital Libraries (DL 1997)*, pp. 233-240. ACM Press, New York, USA.

[41] Marshall, C. C. (1998). Toward on Ecology of hypertext annotation. In: Akscyn (ed.) *Proc. 9th ACM Conference on Hypertext and Hypermedia (HT 1998)*: links, objects, time and space-structure in hypermedia systems, pp. 40 -49. ACM Press, New York, USA.

[42] Marshall, C. C., Brush, A. J. B. (2002). From personal to shared annotations. In: Terveen, D. Wixon (eds.) *Prac. Conference on Human Factors and Computing Systems (CHI)* – Extended Abstract on Human Factors in Computer Systems, pp. 812-813. ACM Press, New York, USA.

[43] Marshall, C. C., Brush, A. J. B. (2004). Exploring the relationship between personal and public annotations. In: Chen, H. Wactlar, C. C. Chen, E. P. Lim, M. Christel (eds.) *Proc. 4th ACM/IEEE-CS Joint Conference on Digital Libraries (JCDL)*, pp.349-375. ACM Press. New York, USA.

[44] Mehrotra, R. and Gary, J. E. (1995). Similar-shape retrieval in shape data management, *IEEE Computer* 28 (9): 5762.

[45] Oard, D. W., & Dorr, B. J. (1996). A survey of multilingual text retrieval text retrieval. UMIACS-TR-96-19-CS-TR-3815.

[46] Oddy, R. N. (1977). Information retrieval through Man-Machine dialogue. *Journal of Documentation*, 33; pp. 1-4.

[47] Picard, R. W. and Minka, T. P. Vision texture for Annotation, technical report, MIT Media Laboratory, No. 302. available at http://citeseer.nj.nec.com/picard95vision.html.

[48] Ponte, J. M., & Croft, W. B. (1998). A language modeling approach to information retrieval. *Proceedings of ACM SIGIR Conference on Research and Development in Information Retrieval*, pp. 275-281

[49] Radecki, T. (1979). Fuzzy set theoretical approach to document retrieval. *Information Processing and Management*, 15 (5), 247-259.

[50] Robertson, S. E. (1977). The probability ranking principle in IR. *Journal of Documentation*, 33; pp. 249-304.

[51] Rong Zhao and William I. (2002). Grosly (2002). Narrowing the semantic gapimproved text-based Web Document Retrieval Using Visual Features, *IEEE Transaction on Multimedia*, 4 (2): 189-200.

[52] Rui, Y., and Huang, T. S. and Chang S. F. (1999). Image retrieval: Current Techniques, Promising Directions and Open Issues. *Journal of Visual Communication and Image Representation* 10 (4): 39-62.

[53] Salton, G. (1963). Associative document retrieval techniques using bibliographic information. *Journal of the ACM* 10, 440-457.

[54] Salton, G. (1979). Mathematics and information retrieval. *Journal of documentation*. 35 (1), pp. 1-29.

[55] Salton, G. and Fox, E. A. (1985). Extended Boolean information retrieval communication of the ACM. 32 (11), pp. 200-210.

[56] Salton, G., Yong, C. S., & Wong, A. (1975). A vector-space model for automatic indexing. Communications of the ACM, 18 (11), 613-620.

[57] Santini, S. (2002). Multimodal search in collections of images and text. *Journal of Electronic Imaging* 11 (4): 455-468.

[58] Sclaroff, S., La Cascia, M., Sethi, S., and Taycher, L. (1999). Unifying textual and visual cues for content-based image retrieval on the World Wide Web, Computer vision and image understanding, 4 (2): 86-98, 1999.

[59] Shipman, F., Price, M. N., Marshall, C. C., Golovchinsky, G. (2003). Identifying useful passages in documents based on annotation patterns. In: T. Koch, I. T. Sølvberg (eds.) *Proc. 7th European Conference on Research and Advanced*

Technology for Digital Libraries (ECDL), pp. 101-112. Lecture Note in Computer Science (LNCS) 2769, Springer, Heidelberg, Germany.

[60] Smeulders, A., Worring, M., Santini, S., Gupta A., and Jain R. (2000). Content-based image retrieval at the end of the early years, *IEEE Trans. PAMI*, December 2000, pp.1349-1380.

[61] Sowa, J. F. (2000). Knowledge representation: Logical, Philosophical and Computational foundation. Pacific Grove, USA: Thomson Learning.

[62] Tamura, H., Mori, S., Yamawaki, T. (1978). Textual features corresponding to visual perception, *IEEE Trans.* On System, Man and Cybernetics 8 (6).

[63] Tian, Q., Hong, P., and Huang, T. S. (2000). Update relevant image weights for content-based image retrieval using support vector machine. *Proc. of IEEE Int'l Conf.* Multimedia and Expo, Vol. 2, NY, 2000, pp. 1199-1202.

[64] Tieu, K., and Viola, P. (2000). Boosting image retrieval. *Proc. of IEEE Conf.* CVPR, June 2000.

[65] Tong, S., and Chang, E. (2001). Support vector machine active learning of image retrieval. *Proc. of ACM Int'l Conf.* Multimedia, Ottawa. Canada, Oct. 2001, pp. 107-118.

[66] Turtle, H., & Croft, W. B. (1991). Evaluation of an inference network-based retrieval model. *ACM Translations on Information Systems*, 9 (3), 187-222.

[67] Van Rijsbergen, C. J. (1979). Information retrieval. Butterworths.

[68] Vasconcels, N., and Lippman, A. (2000). Bayesian relevance feedback for content-based image retrieval. *Proc. of IEEE Workshop on Content-based Access of Image and Video Libraries*, CVPR.

[69] Vickery, B. C. (1970). Techniques of Information Retrieval. London: Butterworth's.

[70] Westerveld, T. (2000). Image retrieval: content versus context. *Proceedings of computer-assisted information retrieval*, Vol. 1, Paris, France, pp. 276-284, 2000.

[71] Wu, Y., Tian, Q., and Huang, T. S. (2000). Discriminant EM algorithm with application to image retrieval *Proc. of IEEE Conf.* Computer Vision and Pattern Recognition.

[72] Yang, C. & Li, K. Wing (2005). Cross-lingual information retrieval: The challenges in multilingual digital libraries. In: Croft, W. B. (2008). Information Access Through Search Engines and Digital Libraries (Eds.), Springer.

[73] Yang, C. and Lozano-Perez, T. (2003). Image database retrieval with multiple-instance learning techniques. *Proc. of the 16th Int'l Conf.* Data Engineering, Santa Diego, CA, 2003.

[74] Yoshitaka, A. and Ichikawa, T. (1999). A survey on content-based retrieval for multimedia databases, *IEEE Transactions on knowledge and Data Engineering 11* (1): 81-93.

[75] Yu. (2004). Statistical learning approaches to information filtering, Dissertation, LMU Munich.

CHAPTER 3 Sec2

SECTION 2

INFORMATION SEEKING

3.2.1) INFORMATION SEEKING MECHANISM

Marchionini (1989a)[57] defined information seeking as a special case of problem solving where learners recognize and interpret in an information problem, establish a plan of search, conduct the search, evaluate the results, and if necessary, iterate through the process again. Kuhlthau (1993)[45] suggested a conceptualization beyond merely seeking and gathering information to a more rigorous constructive process of using information to solve the problem with initiated the information need. Fine (1984)[23] suggested individual engage in information seeking for a number of reasons: to reduce ambiguity; increase their ability to cope with situations, to make decisions, to locate information that will lessen their anxiety, or more toward a desired goal. In a sense, the search event involves problem solving, not simply information finding. It is comparing student activity to the research behaviors of scientists. McNally & Kuhlthau (1994)[61] described how information seeking consists of both undirected and highly directed activities – undirected searching that leads to unexpected links, or discrepant events related to their topics, and highly directed searching for the purpose of finding specific information. These activities formed the basis for students move through predictable stages as they are engaged in these information-seeking activities. They claimed students' progress from ambiguity to clarity, from seeking general information to seeking specific information. Kuhlthau (1993)[45] described how learners commonly experience a series of phases as they seek information over extended periods. An affective, cognitive, and physical description of these phases includes:

1. Initially, the learner first becomes aware of a lack of knowledge or understanding, and recognizes a need for information. Learners often

experience feelings of uncertainty, and thoughts are often vague and ambiguous regarding the information problem.

2. Selection: The learners' task is to identify and select a general topic for investigating and develop an approach for pursuing the information. After a topic is selected, learners often experience a brief sense of optimism replacing the previous feelings of uncertainty.
3. Exploration: This phase is often the most difficult for learners, as the task is to investigate information on a specific problem or question in order to extend personal understanding. Learner thoughts center on becoming oriented and sufficient informed about the topic in an effort to begin formation of a focus or personal viewpoint. Learners often experience feelings of confusion, uncertainty, and doubt during this phase. Specifically, learners may experience two forms of uncertainty: conceptual – what information the learner is looking for, and one related to the technical process of information retrieval – how to make use of the search instruments (i.e. databases, search tools, interface options, commands).
4. Formulation: The task in this phase is to form a clear focus from information encountered during exploration. During this phase, feelings of uncertainty diminish and confidence increases, as learners perceive this stage as a turning point in their process of information seeking.
5. Collection: In this phase, the learner and system interact most effectively and efficiently.

6. Presentation: The central task at this phase is to complete the search and resolve the problem or question. Learners complete the search with a gain in personal understanding.

Given the fact that digital objects carry information in digital libraries and their respective metadata specifications, the proposed dimensions of quality for these two concepts can be connected to the life cycle of information in digital libraries (Borgman, 1996)[8]. Such connections can be used to determine when and where quality indicates can be measured, accessed, and improved – as well, as how possible quality problems can be prevented, detected, and eliminated. The connections are shown in Figure (3.2.1.1). The life cycle (see inner portion) has four major phases: information creation, distribution, seeking, and utilization. The outer arrows show in which stage information is active, semi-active, or inactive with regard to the phases. Each major phase (see inner ring) is connected to a number of activities or services. Finally, (see outer ring), each dimension of quality is associated with a corresponding set of activities/services. Similarity to other information, digital objects, or versions can be accessed at time of creation and modification. Preservability and timeliness (in relation to modifications) also are related to this phase.

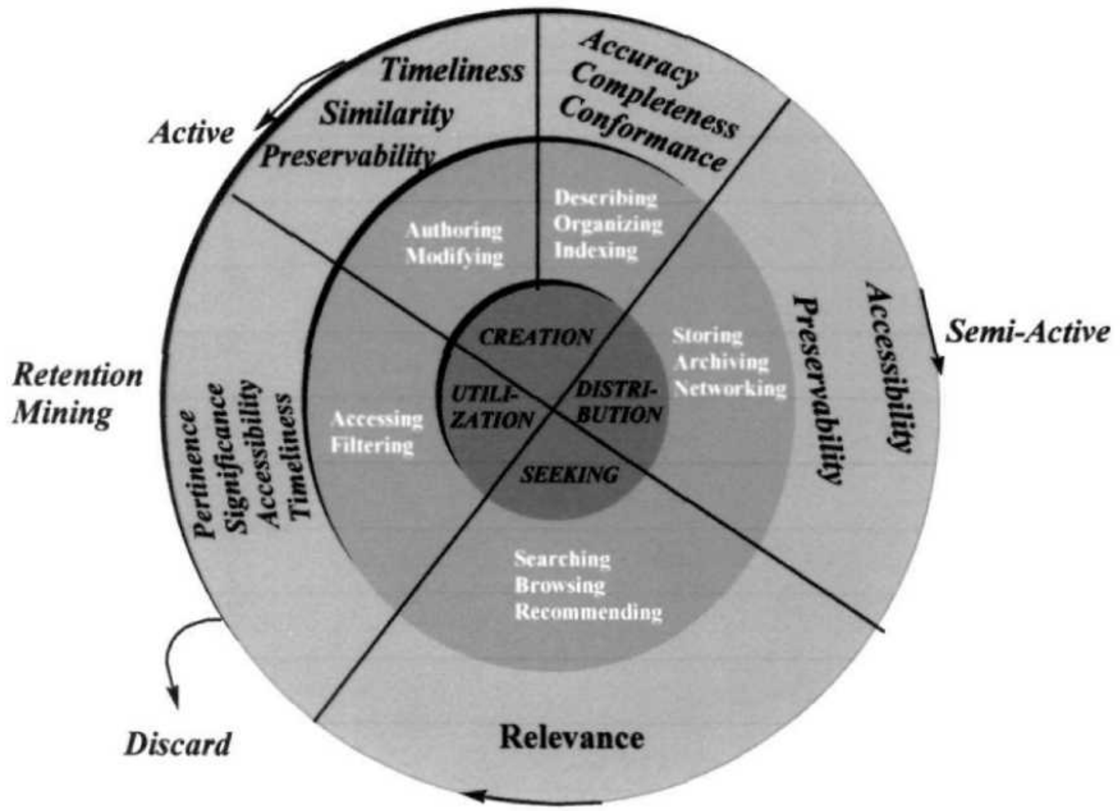


Figure (3.2.1.1). Information life cycle (Borgman (1996)[8]) with respective dimensions of quality added for each major phase and related activities.

The next sub phase in the cycle deals with metadata creation and information organization and description; therefore, all quality dimensions associated with metadata specifications are located here. Special metadata quality processes such as enforcing filling out of mandatory fields and use of specific formats (e.g., for dates) as well schema validations, should be applied to related activities to guarantee quality (namely, accuracy, completeness, and conformance). In the next phase of archiving and distribution, the aspects of accessibility (e.g., means of storage, format, position in an organizational scheme, etc.) should be taken into consideration. In the seeking (e.g., searching) phase, relevance of information as returned by the several information satisfaction services can be measured. Finally, most of the dimensions associated with the perceived value of the information (pertinence, significance) can be assessed during the utilization phase.

3.2.2) RELATIONSHIP BETWEEN LEARNING AND INFORMATION SEEKING

Information seeking and learning processes cannot be separated (Cole, 1999[14]; Marchionini, 1995[58]). Information seeking considered a response to some problematic tasks or situations characterized by uncertainty. The resolution of this uncertainty constitutes a change in the learner's knowledge state (Ford, 2003[26]) that leads to learning. Under different information seeking scenarios, the change in knowledge state can be attributed to different modes of searching and browsing (Choo, Detlor, & Turnbull, 2000[13]). In contrast, different conceptions of learning exist. Learning can be seen as problem solving, as inquiry, as sense-making, as intellectual socialization, as design and as constructivist activity by which the learner builds his/her own knowledge (Smith, 1993[86]). Inherent in all these conceptions of learning are changed in the learner's state of knowledge, which results in learning. The interactive process of information gathering and processing, during an inquiry process, comes on an end when the learner can explain a phenomenon or when the learner achieves a state of certainty about some posed question. A careful comparison of the goals and mechanisms of information seeking and learning reveals their similarities and inseparability. Limberg (1999[51]) had also reported a significant interaction between the process of information seeking and learning. Under the light of the basic mechanisms involved and the evidence provided by the literature, we can see that both information seeking and learning alter the learner's knowledge state and that clearly, information seeking is encompassed by learning, as also is shown in Figure (3.2.2.1.) bellow:

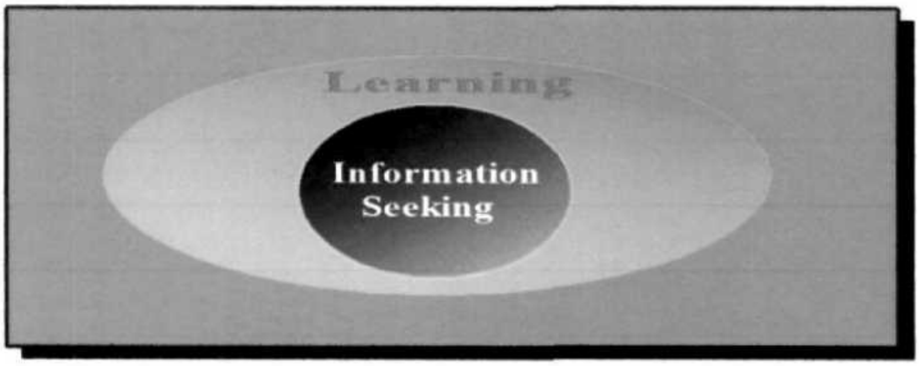


Figure (3.2.2.1). Relationship between information seeking and learning (Faisal Ahmed, 2004[3])

This is also evident from proposed information seeking and learning models (e.g., (Kuhlthau, 1993[45]), (Choo et al., 2000[13]), and (Ellis, 1993[21])). It is clear from the discussion presented in this section that information seeking addressed several aspects of learning at a fine granularity. The learning process is implicit in searching, but a learner can greatly benefit by explicit support for learning according to different learning conceptualizations (Faisal Ahmed, 2004[3]).

3.2.3) RELATIONSHIP BETWEEN DIGITAL LIBRARY, INFORMATION SEEKING, AND LEARNING

Learning is the process by which we acquire and retain attitudes, knowledge, understanding, skills and capabilities that are not a part of inherited behavior patterns or physical growth. It deals with an act, process or experience of gaining knowledge or skill through exposure to a variety of resources during study. Learning is a way of interacting with the world. Kolb (1984[43]) argued that defining learning in terms of the change of behavior is not enough to define the learning process. Kolb[43] defined learning as an adaptation process. "It is a process whereby knowledge is created through transformation of experience". Sue Roberts (2006[91]), discussed the deep learning approaches in four directions that are first, a learning as active, situated, and social; second, constructivist perspectives; third, learner-focused pedagogy; and finally, developing metacognitive & other skills. He also described the role developments with three elements academic, learning technologist, and academic librarian. The important question is that how do libraries support teaching and learning?

To answer this question we should discuss the roles of digital library in learning. According to Cory Marchionini and Hermann Maurer (1995[15]) who indicated that libraries serve at least three roles in learning: first, they play a practical role in sharing expensive resources. A community of users shares physical resources such as books and periodicals, films and videos, and software and electronic databases, and specialized tools, such as projects, graphics equipment, and cameras. Human resources – librarians (also called media specialists or information specialists) – support instructional program by responding to the requests of teachers and students (respective services) and by initiating activities for teachers and students (proactive services). Responsive services include maintaining reserve materials, answering reference questions, providing bibliographic instruction, developing media packages, recommending books or films, and teaching users how to use materials. Proactive services include selectively disseminating information to faculty and students, initiating thematic events, collaborating with instructional to plan instruction, and introducing new instructional methods and tools. In these ways, libraries serve to allow instructors and students to share expensive materials and expertise. Second, libraries serve a cultural role in preserving and organizing artifacts and ideas. Great works of literature, art, and science must be presented and made accessible to future learners. Although libraries have traditionally been viewed as facilities for printed artifacts, primary and secondary school libraries often also serve as museums and laboratories. Libraries preserve objects through careful storage procedures, policies of borrowing and use, and repair and maintenance as needed. In addition to preservation, libraries ensure access to materials through indexes, catalogs, and other aids that allow learners to locate items appropriate to their needs. Third, libraries serve social and intellectual roles by bringing together people and ideas. This is distinct from the practice role of sharing resources in that libraries provide a physical place for teachers and libraries to meet outside the structure of the classroom, thus allowing people with different perspective to interact in a "knowledge space" that is both larger and more general than that shared by any single discipline or affinity group. Browsing through a catalog in a library provides a global view for people engaged in specialized study and offers opportunities for serendipitous insights altemative views. In many respects, libraries serve a centers of interdisciplinary – place shared by learners from all disciplines. Digital libraries extend such interdisciplinary by making diverse information resources available beyond the physical space shared by groups of learners. Hence, Cory Marchionini and Hermann Maurer (1995[15]) denoted to one of the greatest benefits of digital libraries is bringing together people with formal, informal, and professional learning missions as follows: First, formal learning is systematic and guided by instruction. It takes place in courses offered at schools of various kinds and training courses or programs on the job. The important roles libraries serve in formal learning are illustrated by their physical prominence on university campuses and the number of courses that make direct use of library services and materials.

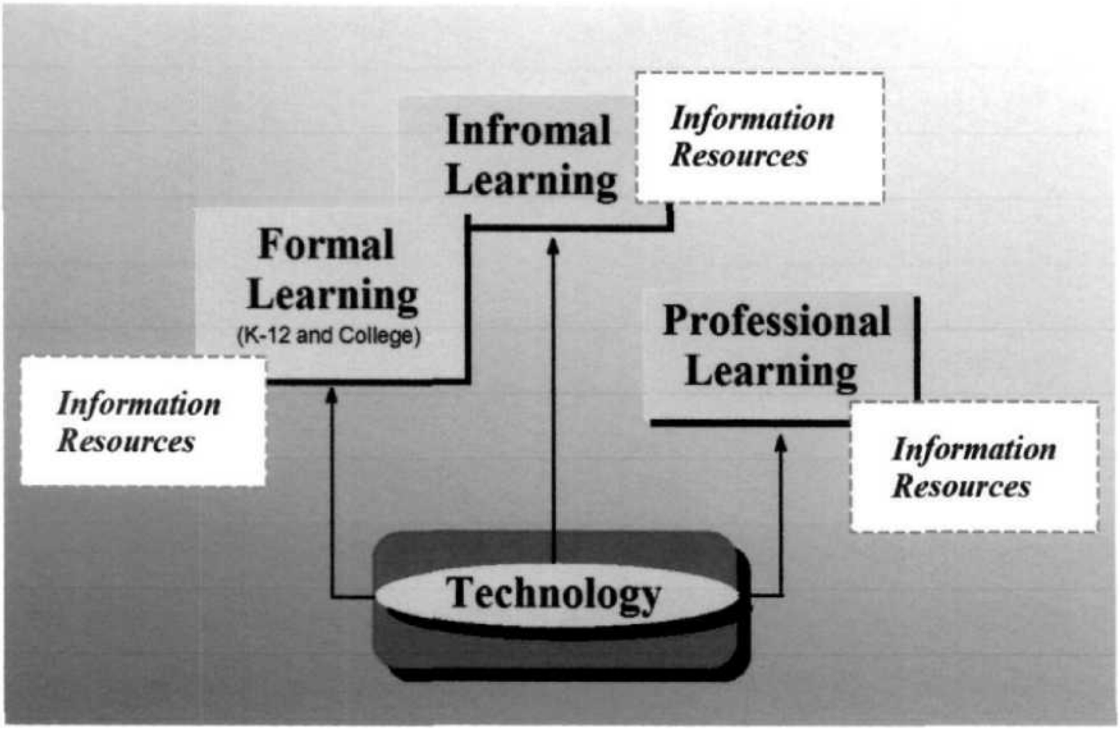


Figure (3.2.3.1). Current model of technological support for different types of learning

(Cory Marchionini and Hermann Maurer (1995[15]))

Second, digital libraries open new learning opportunities for global rather than just local communities. Learners take advantage of other people, mass media, and their immediate environment during informal learning. Third, professional learning refers to the ongoing learning adults engage in to do their work and improve their work-related knowledge and skills. The main information resources for the professional learning, however, are personal collections of books, reports, and files; subscriptions to journals, and the human networks of colleagues nurtured through professional meetings and various communications. Many of the data sets and computational tools of digital libraries were originally developed to enhance professional learning. Digital libraries combine technology and information resources to allow remote access, breaking down the physical barriers between resources. Although these resources will remain specialized to meet the needs of specific communities of learners, digital libraries will allow teachers and students to take advantage of wider range of materials and communication with people outside the formal learning environment. This will allow more integration of different types of learning, as depicted in Figure (3.2.3.2) as shown bellow:

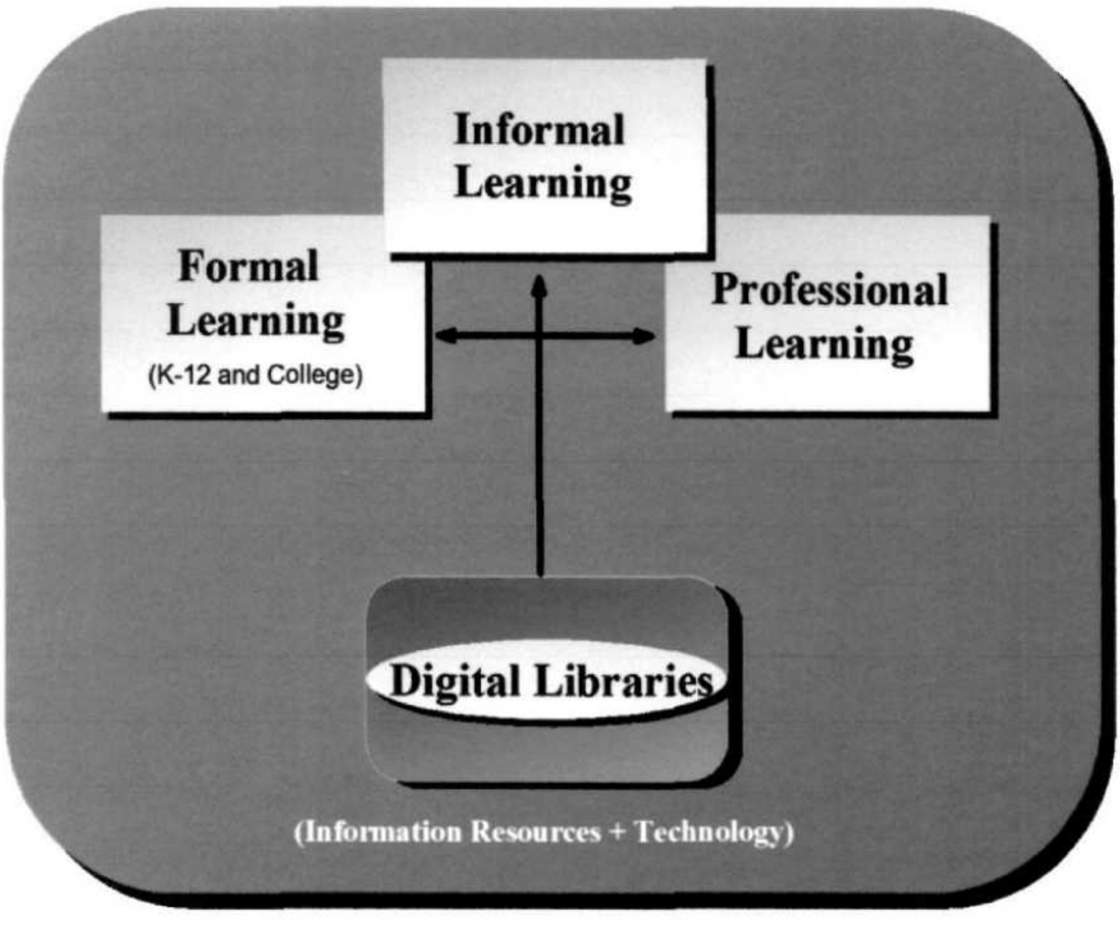


Figure (3.2.3.2). Digital libraries lead to integrated resources and types of learning (Cory Marchionini and Hermann Maurer (1995[15]))

Digital libraries will allow learners of all types to share resources, time and energy, and expertise to their mutual benefit. For example:

a-) textual databases of classic words and image collections for important artistic exhibits or museums have been assembled by scholars and made available through the Internet (Santa and Calif, 1994[76]).

b-) although electronic journals are becoming more common, they have not penetration as many expected (Oldyzko, 1994[68]; Schaffner, A., 1994[79]). Two common approaches to electronic journals are: to store files in LaTex, PostScript or ASCII form in a fileserver and email the files or allow FTP access to them (generic approach); and to store documents in hypermedia systems and allow on-line browsing and perusal (hypertext approach).

c-) new reading and filtering programs (Ahlberg et al., 1994[2]; Stevens, C., 1993[90]) and search tools such as Archie and Veronica (Deutsch, P., 1992[19]) provide rudimentary aids for locating information in these electronic discussions.

d-) a variety of hypermedia materials are becoming available, and these collections are often served from a library rather than through dedicated machines in classroom (Crane, G., 1994[17]; Mylonas, E., 1992[63]).

Furthermore, learning and digital library have two distinct components: Learning related to accessing evaluating and using the information resources available in this environment; and learning related to mastering and building upon the ideas embodied within those individual resources (Delia Neuman, 1997[18]). Explorations of the relationship of cognitive theory to instructional technology have in fact co-existed with behaviorist ideas in the instructional technology community for years, and the field has a long history of drawing on both traditions to explore the relationship of media and learning. For example, Kozma (1994[44]) offered his conclusions and insights as argument of reframing instructional technology's longstanding debate on the contributions of media to learning:

> "Perhaps we should ask, what are the actual and potential relationship between media and learning? Can we describe and understand this relationship? Moreover, can we create a strong and compelling influence of media on learning through improves theories, through improves research, and through improves instructional designs?" (Kozma, 1994[44]; p.233)

Liebscher and Marchionini (1988[50]), Neuman (1993[65], 1995a[66], 1995b[67]) and Soloman (1993[87], 1994[88]) all suggested important capabilities that students must acquire to use text-based electronic information resource successfully; Large et al. (1994a[46], 1994b[47]), Perzylo and Oliver (1992[71]), and Small and Ferreira (1994[83]) performed the same function for multimedia materials.

One of the enduring works in instructional technology was Malcolm Fleming and Howard Levie's (1978[24]) Instructional Message Design: Principles from the behavioral Science – re-issued in 1993 as Instructional Message Design: Principles from the Behavioral and Cognitive Sciences. The 1993 edition combined findings from both traditions of learning theory to specify over 300 research-based guidelines for designing instructional presentations in various print and non-print formats – and over 200 of these address issues that can be applied to creating components of digital library. Even such simple principles as "Purely decorative pictures should be used sparingly" (Fleming & Levie, 1993[25], p.89) and "Logically organized text is better remembered than poorly organized text" (p.208) provided useful insights about how components of the digital library might be organized and presented to increase students' likehood of learning in this environment. More complex principles – such as "The acquisition of unfamiliar content can be improved via familiar examples, analogies, and metaphors, while such strategies are less essential for familiar content" (Fleming & Levie, 1993[25], p.215) and "The presentation of visually richer and more realistic best examples leads to a richer and better consolidated prototype resulting in increased transfer" (p.244). "Macro-level environments" include both rich collections of resources and tools students use to explore them "to pursue interests or needs beyond the parameters typically provided in isolated lessons" (Hannafin, 1992[30], p.58); "Micro-level environments" offered similar arrays of materials but focus within more discrete domains. "Mathemagenic environments" supported access to various representations of content in a particular area (often through hypermedia links) and allowed students to "move rapidly among networks of concepts (and) to construct their own sets of relationships within the network" (p.59). Cora Busstra (2008[11]) discussed five principles for the design of digital learning material for academic education in human nutrition. These principles were as follow:

Principle1: Motivate the students.

Digital learning material provides sufficient opportunities to implement these principles and to motivate the student.

Principle2: Authentic learning content.

Active construction of knowledge can be supported by providing meaningful, realistic and authentic learning contexts, which reflect the way knowledge is used in "real-life" (Brown JS, Collins A, Duguid P., 1998[10]; Honebein PC, Duffy TM, Fishman BJ, 1993[34]). Digital learning material provides many opportunities to provide an authentic learning context. For example, digital learning material can be used to provide a simulated virtual laboratory environment in which the student can freely design and try out experiments (Wilmsen T., Hartog R., Biseeling T., 2002[98]; Diederen J., Gruppen H., Hartog R.,Voragen GJ., 2006[20]).

Principle3: Active Learning.

Active learning and practice is necessary for strengthen understanding, acquiring knowledge and retention knowledge (Anderson JR., 2000[4]; Sweller J., Van Merrie□nboer JJG., Paas FGWC., 1998[92]). Especially digital learning material provides many opportunities to engage each student individually in studying. With digital learning material a broad range of interactive exercises (like drag and drop questions, multiple-choice questions etc.) and other activities (e.g., interactive simulations, interactive practice possibilities for data analysis) can be provided that will stimulate the student to learn actively.

Principle4: Visualization of important concepts.

An important benefit of digital learning material is the possibility to use dynamic visuals (e.g., interactive diagrams, animations and video clips) which are more elaborated than figures in text books (Lawalter D.,2003[49]; Mayer RE., 2002[60]). Mayer[60] discussed that "the promise of multimedia learning is that students can learn more deeply from well-designed multimedia messages consisting of words and pictures than from more traditional modes of communication involving words alone" (Mayer RE., 2002[60]). Furthermore, it is suggested that well-designed images or diagrams can improve understanding and retention of knowledge (Sweller J., Van Merrie□nboer JJG., Paas FGWC., 1998[92]; Larkin JH., Simon HA., 1987[48]; Schnotz W., 2002[80]). With respect to visualization, the challenge during the design of the digital learning material is to investigate which representations (such animations, schemes, pictures etc.) are adequate to clarify a certain rule, concept or principle.

Principle5: Reduce unnecessary cognitive load.

According to cognitive load theory, an individual's cognitive capacity is limited. There is a certain amount of information, which a student can process at a certain time (Sweller J., Van Merri□nboer JJG., Paas FGWC., 1998[92]; Baddeley AD., 1992[6]; Kirschner PA., 2002[42]). Digital learning material provides several opportunities to prevent cognitive overload. One principle is the use of Just-In-Time (JIT) information presentation (Kaster L., Kirschner PA, Van Merrie□nboer JJG, Baumer A., 2001[40]). This means providing the student with information and feedback at exactly the moment he needs this information to perform a task.

Goodrum, Dorsey & Schwen (1993[29]) described the conceptual and practical difficulties in designing an "enriched learning and information environment" that accommodates the difficulties that Perkings (1991[70]) had identified for students operating with such a setting: high cognitive load, increased responsibility for managing their own learning, and need to adopt an unfamiliar learning process. Scardamalia and her colleagues (1989[78], 1992[77]) had worked for years on the development and refinement of CSILE – "Computer-Supported International Learning Environment" – a shell that allows students to create their own knowledge base related to classroom instruction by working collaborative in an electronic environment to generate hypotheses, ask questions, and revise their understanding of that information. Rieber (1990[74], 1996[75]) had explored how both animation and elements of simulations and games can enhance students' abilities to focus on and learn from multimedia "micro worlds". Hannafin, Hall, Land, and Hill (1994[31]) noted the lack of compelling empirical evidence of how open-ended learning environment influence learning and, further, discussed the difficulty of obtaining such evidence. Hannafin[31] and his group had compiled a set of empirically based guidelines for designing interactive multimedia that might provide some insights into how components of the digital library might be designed to enhance teaching (Park & Hannafin, 1993[69]).

M. A. Gopinath (1996)[54] indicated to the curriculum design that the organization of learning experiences for library and information professionals involves vertical and horizontal relationships. The vertical relationship among learning experiences is worth reference to time – the first semester, second semester etc. The horizontal relationship is in terms of one area to another, for instance, the first semester talks of information and its usage; the second semester on system technology and the third semester combines both in terms of human computer interface for information access and assimilation. Sridhar (1996[55]) discussed the impact of electronic of libraries/media on education that aid all types of education – formal, informal, adult, vocational, distance and higher education (p.236). Natalie and San Pang (2005[64]) discussed specifically at the process of learning between peers in a group and how digital libraries can lend themselves as a learning environment towards this purpose. Natalie[64] and San Pang according to Tosey & Gregory (1998[93]) identified five characteristics, providing a contextual design for peer learning. These five characteristics are Personal Development, Community Interaction, Facilitation, Formal Independence, and Boundary Management. Natalie[64] and San Pang concluded that digital libraries could be implemented as learning environments –

involving resources, services, tools, and a profiled community of users. Digital libraries are potentially highly interactive environments encouraging electronic learning between its users. Logue (2003[52]) discussed that the role of libraries in providing instructional supports has changed to one of a more dynamic nature in recent years – developing new digital resources and services for the purpose of distance learning, teaching aids, or support for the academic faculties in students' research and coursework. Microsoft (2003[62]) in Singapore, many digital libraries have evolved in education. One of the most significant implementations is IVLE (Integrated Virtual Learning Environment); developed initially by the National University of Singapore. Jose et al. (2002[39]), Kearsley (2000[41]) with the proliferation of digital libraries in education, institutions and schools are realizing the benefits of digital libraries to provide new opportunities for learning activities. Marlion et al.[59], Mayer and Moreno (2002[60]) and Rapp et al.[72] cognitive psychologists, instructional designers, and others coming from an educational research background often highlight the role that digital libraries can play as cognitive tools to support the learning and sense- making activities of individual users. This view focuses on how people can make use of multimedia resources in digital libraries to construct their own knowledge representation, and typically draws on cognitive theories such as constructivist learning or those taking a human-interaction processing perspective. MacDonald et al. (1999[56]) denoted to that in distance learning literature, this is often referred to as 'resource-based learning' which strives to offer learners choices in their learning materials and to accommodate individual differences through the provision of a wide selection of typically related, multimedia learning resources. As such, resource-based learning requires learners to grapple with both the topic of study and information seeking and information handling skills. Renninger & Shumar (2002[73]) discussed how specific Math Forum services, and participation in the broader Math Forum Community, helped teachers to reconceptualize themselves as linking mathematics rather than being math phobic, and thus increasing their own personal skills in mathematics and changing the way they taught math in their classrooms. M. A. Goncalves (2004[53]) discussed the 5S framework that Fox and his students at Virginia Tech have been developing a formal model of DLs based on Streams, Structures, Spaces, Scenarios, and Societies, hereafter related to as "5S". "Streams" described all types of content as well as communications. "Structures" described organizational schemes, including data structures, database, and knowledge representations. "Spaces" cover 2D and 3D interfaces, GIS data, and presentations of documents and queries. "Scenarios" are specified as system states and events. "Societies" describe both software "service managers" and generic "actors" who may be human users or machine processes, or collaborations of one or more of both (see table 3.2.3.1).

Table (3.2.3.1). 5S Framework (Goncalves, 2004[53])

5S	Examples	Formalization
Streams	Text, audio, video, image	Sequence (list)
Structures	Collection, catalog, hypertext, document, metadata, taxonomy	Graph, Function, Relation
Spaces	Used in indexing, browsing, and searching services- as well as interfaces	Set(vector, topological, measurable, measure, probability spaces)
Scenarios	Searching, browsing recommending	States, events, sequences (lists)
Societies	Service manages (software), Actors (learners, teachers etc.)	Tuple (relating events and actions)

Borgman et al. (2000[9]) observed the use of the Alexandria Digital Library Prototype in college-level geography classrooms and labs by both teaching faculty and students. Janee & Frew (2002[35]) the Alexandria Digital Library provides an innovative resource discovery service enabling users to retrieve geo-referenced maps and images based on geographic location. Abbas et al. (2002[1]) at the K-12 level examined the use of the Artemis Digital Library by middle school students in 32 schools.

3.2.4) SCAFFOLDING AND PERSONALIZATION IN DIGITAL LIBRARIES

Nowadays, research in information seeking has shed light on the complexity of the process, the different stages embedded within the process, and problems faced by the users during information seeking (Hirsh, 1997[33]; Shenton & Dixon, 2004[12]; Fidel et al, 1999[22]; Ford, 2003[26]; Choo et al., 2000[13]; Shenton & Dixon, 2003[81]; Wilson, 1999[99]; Watson, 1998[97]). Two prominent research directions in the digital library community have addressed this concern: providing task support, and personalizing interactions. Task support, to increase the effectiveness of information retrieval systems, researchers has realized the importance of providing task-specific support to users (Jarvelin & Ingwersen, 2004[36]). Therefore, a number of studies have appeared such as, the work by Vakkari (2000[94], 2001[95]) investigated the information needs associated with each stage in writing a master's research proposal. Vakkari[95] found that during the three tasks the students used stages (pre-focus, focus formations, and post-focus) different types of information. Therefore, a number of digital library systems have emerged embed tools and processes to support task specific performances. ARTEMIS used a learner-centered design (Soloway, Guzdial, & Hay, 1994[89]) to scaffold the inquiry-learning process via information seeking (Wallace et al., 1998[96]; June Abbas & Soloway, 2002[1]). In designing the ARTEMIS digital library the authors first identified the difficult-to-do task stages and then coupled these stages with appropriate tool support. In summary, ARTEMIS provides task structuring tools, guiding prompts, and reflection tools to scaffold the inquiry-learning process. A similar approach has been adopted by the science, mathematics, engineering and technology (SMETE) digital library (Andy & Alice M., 2001[5]). In designing SMETE, a deep understanding of the learner and educator's work is used to identify four key areas of support within a digital library interface, which are information organization, and information search. Personalization, the DELOS/NSF Working Group on Personalization and Recommender System for digital libraries has suggested that digital libraries lacking individual and community-based personalization capabilities might be considered as failing their constituencies (A. Smeaton & Callan, 2002[85]). In a synthesis of discussions of this working group, Smeaton & Callan[85] had proposed that the future of personalization in digital libraries includes the following research agenda challenges: richer user model, innovative personalization and recommender algorithms, more flexible user interactions, improved evaluation methods, and increase focus on the social effects enabled by digital libraries (A. F. Smeeton & Callan, 2005[84]). Therefore, one of the important factors in this research is the interaction and interface personalization that it will discuss later in this section. Interaction modeling within digital library environments can provide a way to highlight usability issues and identify points of support where personalization can be most effective. For example, in the Corporate Digital Library (CDL) (Costabile, Esposito, Semeraro, & Fanizzi, 1999[16]), user interaction logs are collected and classified into novice, expert, and teacher. DAFFODIL is another example of a system that makes recommendations based on analyzing user interaction paths (Fuhr et al., 2002[28]). In addition to system development, empirical studies have been performed to define a generic interaction framework for digital libraries. Byran-Kinns et al. (2000[12]) defined a five level interaction framework for analyzing and designing digital libraries, which are Properties, Causes, Symptoms, Traces, and Fundamentals. Interestingly this interaction framework can be used to decompose the popular four levels of search activities in information seeking environment (Bates, 1990[7]), which are level1 (move), level2 (tactic), level3 (stratagem), and level4 (strategy). Faisal Ahmed (2004[3]) noted that exploratory learning environments reflect the conviction that students should be responsible for their own learning and should be empowered to take control of their learning processes. Under these philosophical commitments, learning environments and digital libraries approximate human scaffolding. Therefore, one of the basic issues with approaches to enabling learning with digital libraries is that learning is considered a process separate from information seeking. Due to this underlying assumption, Shallow user models that provide superficial personalization are mostly used in digital library personalization research. Recent literature has realized this problem and called for deeper user modeling for providing adaptive support in digital libraries (Frias-Martinze, Magoulas, Chen, & Macredie, 2006[27]). Therefore, Jayawardana et al. (2001[38]) discussed that personalized information environment (PIE) in a digital library is a framework that provides a set of integrated tools based on individual user's requirements and interests with respect to his access to library materials. These tools can support active learning by integrating the user's personal library and a remote digital library. The user will be able to carry out learning activities when browsing the digital library. There are two schemas involved in PIE. Material personalization corresponds to facilities for learners to use library materials according to their individual requirements such as active consuming and information gathering. Collection personalization, on the other hand, captures the learner's content and interest from material personalization in order to provide a personalized view of the organization retrieving. In PIE, these two schemas of personalization benefit each other by creating the cycle of interaction. Therefore, it is possible the three main active learning facilities in the PIE for the digital library.

In this architecture, there are two main components called DL Browser and Personal Document Editor. DL Browser supports the collection personalization and Personal Document Editor supports material personalization. Two information-seeking tools, which are personalized retrieving and personalized filtering, are provided in the DL Browser. On the other hand, tools for active consuming and information gathering are available in the Personal Document Editor. The interaction of both the DL Browser and the Personal Document Editor provide an interface for the digital library. Jayawardana et al. (2000[37], 77-84) indicated that the personal documents are categorized according to the following areas: Personalized Books, Personalized Articles, Personalized Video/Audio, and Notebooks. Personalized Books and Personalized Articles support the learner's active reading process, providing personalized view of static library materials. Personalized Video/Audio supports active watching and active listening processes and gives personalized views of audio-visual library materials. The Notebook, which represents the learner's information gathering, allows the user to integrate different segments that can be text, images, audio or video together with annotations. Manipulating of those personal documents is carried out by personal library functions, which include annotating, segmenting, formatting, modifying, organizing and integrating. Therefore, Shallow Copy is the main technique that is used to create Segments from the existing multimedia library materials. With Shallow Copy, only a pointer to the part to be copied is stored, and no physical copy of the material is made. In personal documents, Shallow copied segments are used instead of simple hyperlinks. Since the internal representation varies with respect to media type, the design of Shallow Copy technique depends on the media type of the selected source. There are three categories, namely open formats corresponding to all text encoding such as HTML, XML and ASCII; print formats such as Postscript generally contains both text and images together; and Proprietary formats, for example Microsoft Word, usually come with an application programmers interface (API). A Shallow copied segment consists of three attributes: document identifier, being offset address and end offset address. Each segment contains two declarations called physical and logical. The physical declaration of document identifier would be URL or URL of the source object and it becomes invalid when the object is not retrieved or located. Therefore, the contents of the logical declaration will be used to identify it. The offset address and end offset address contain values that can be used to retrieve the segment from the documents. Image objects are also represented in a variety of formats such as JPEG, GIF, and BMP. The internal representation of these image objects vary significantly from each other and the platform (operating environment) also effects their representation. Since it is difficult to have a unique mechanism to present the Shallow copied image segment, we use a virtual coordinate system to map them in order to calculate the offset addresses uniquely and it is maintained in a device independent form. Furthermore, the virtual coordinate approach used to describe the Shallow segments taken from files or print formats. The data type of video/audio data is completely different from text and image types, since the appearance of video/audio data depends on the time. Although there are varieties of data formats for their representation, both the audio and video data are function of time when they are played. Shallow Copy uses time as the user specified parameter to identify segments of audio and video library materials.

Therefore, when opening a personal document using the browser, the dynamic video sources are generated based on the information in the Shallow video clips of the document. Such sources could stay in the temporary buffer during the activation time of the personal document but are not stored. Hewagamage et al. (2001[32]) denoted to that the Shallow Copy technique demonstrates definite advantages in the case of multimedia data types such as audio/video data, which take a large amount of storage space.

REFERENCES

[1] Abbas, J., Norris, C. and Soloway, E. (2002). Middle school children's use of ARTEMIS Digital Library. *In ACM/IEEE Joint Conference on Digital Libraries (JCDL'02)*, (Portland, Oregon (July 14-18),2002), ACM Press, 98-105.

[2] Ahlberg, C., Williamson, C., and Shneiderman, B. (1994). Dynamic queries for information exploration: An implementation and evaluation. In the sparks of innovation in human-computer interaction, B. Shneiderman, Ed. Ablex, Norwood, N. J., pp. 281-294.

[3] Ahmed, Faisal (2004). Generating conceptually personalized interactions for educational digital libraries using concept maps. Thesis, UMI No. 3337215.

[4] Anderson JR. (2000). *Cognitive Psychology and its Implications*. 5th ed. USA: Worth Publishers.

[5] Andy Dong and Alice M. Agogino (2001). Design principles for the information architecture of a SMET Education Digital Library *In IEEE/ACM Joint Conference on Digital Libraries.* Roanoke, VA, USA. Available at URL: www.engineeringpathway.com/smete/public/about_smete/publications/JCDL-0601/dongagoginojcdl01-01.pdf.

[6] Baddeley AD. (1992). Working memory. Science. 225: 556-9.

[7] Bates, M. (1990). Where should the person stop and the information search interface start? *Information Management, 26 (5)*, 575-591.

[8] Borgman, C. L. (1996). Social aspects of digital libraries. In: E. A. Fox & G. Marchionini (Eds.), *Proceedings of the 1st ACM International Conference on Digital Libraries* pp. (170-171). Bethesda, MD.

[9] Borgman, C. L., Leazer, G. H., Gilliland-Swetland, A. J. & Gazan, R. (2000). Evaluating digital libraries for teaching and learning in undergraduate education: A case study of the Alexandria digital earth prototype (ADEPT). *Library Trends, 49(2)*, 228-250.

[10] Brown, J. S., Collins, A., Duguid, P. (1998). Situated cognition and the culture of learning. *Educational Researcher, 18*, 32-42.

[11] Busstra, M. C. (2008). Design and evaluation of digital learning material for academic education in Human Nutrition. Thesis Wageningen University, The Netherlands, 2008 – with summary in Dutch. 841-1.

[12] Byran-Kinns, N., Blanford, A., & A thimbleby, H. (2000). Interaction modeling for digital libraries. In Workshop on Evaluation of Information Management System. Landon, UK.

[13] Choo, C. W., Detlor, B., & Thumbull, D. (2000). Information seeking on the web: An integrated model of browsing and searching. First Monday, 5 (2).

[14] Cole, C. (1999). Activity of understanding problem during interaction with an "enabling" information retrieval system: Modeling information flow. *Journal of American Society for information Science*, 50 (6), 544-552.

[15] Cory Marchionini and Hermann Maurer (1995). The role of digital libraries in teaching and learning. *Communication of the ACM, April 1995/vol. 38,* No.4.

[16] Costabile, M. F., Esposito, F., Semeraro, G., & Fanizzi, N. (1999). An adaptive visual environment for digital libraries. *International Journal on Digital Libraries, 2,* 124-143.

[17] Crane, G. (1994). *Perseus 2.0 Yale University Press*. New Haven Ct.

[18] Delia Neuman (1997). Learning and the digital library. *Library Trends, Vol. 45,* No. 4, Spring 1997, pp. 687-707.

[19] Deutsch, P. (1992). Resource discovery in an Internet environment – The Archie approach. Electronic. Networking: *Res.Appl. Policy 1,2*, 45-51.

[20] Diederen J., Gruppen H., Hartog R, Voragen GJ. (2006). Design and evaluationof digital assignments on research experiments within food chemistry. *Journal of Science Education and Technology. 15*: 227-46.

[21] Ellis, D. (1993). Acomarison of the information seeking patterns of researchers in the physical and social sciences. *Journal of documentation,* 49 (4), 356-369.

[22] Fidel, R. K., Douglass, M. H., Holder, J. K., Hopkins, C. J., Kushner, E. J., et al. (1999). A visit to information mall: Web searching behavior of high school students. *Journal of American Society for information Science, 50 (1),* 24-37.

[23] Fine, S. (1984). Research and the psychology of information use. *Library Trends, 32 (4)*, 445-446.

[24] Fleming, M., & Levie, W. H. (1978). Instructional message design: Principles from the behavior sciences. Englewood Cliffs, NJ: Educational Technology Publications.

[25] Fleming, M., & Levie, W. H. (Eds.) (1993). International message design: Principles from the behavioral and cognitive sciences (2d ed.). Englewood Cliffs, NJ: Educational Technology Publications.

[26] Ford, N. (2003). Modeling cognitive processes in information seeking: From popper to pask. *Journal of American Society for information Science*, 55 (9), 769-782.

[27] Frias-Martinze, E., Magoulas, G., Chen, S. & Macredie, R. (2006). Automated user modeling for personalized digital libraries. *International Journal of Information Management*, 26 (3), 234-248.

[28] Fuhr, N., Klas, C.-P., Schaefer, A., & Mutschke, P. (2002). Daffodil: An integrated desktop for supporting high-level search activities in federated digital libraries. *In Research and advanced technology for digital libraries. 6th European Conference ECDl* pp. 597-612. Rome, Italy: Springer.

[29] Goodrum, D. A.; Dorsey, T.; & Schwen, T. M. (1993). Defining and building an enriched learning and information environment. *Educational Technology, 33 (11)*, 10-20.

[30] Hannafin, M. J. (1992). Emerging technologies, ISD, and learning environments: Critical perspectives. *Educational Technology Research Development*, 40 (1), 49-63.

[31] Hannafin, M. J.; Hall, C.; Land, S.; & Hill, J. (1994). Learning in open-ended environments: Assumptions, methods, and implications. *Educational Technology, 34 (10)*, 48-55.

[32] Hewagamage, K. P., C. Jayawardana and M. Hirakawa (2001). Shallow copying of multimedia sources for virtual documents. *Proceedings of IEEE International Conference of Multimedia & Expo*. August. Forthcoming.

[33] Hirsh, S. G. (1997). How do children find information on different types of tasks? Children's use of science library catalog. *Library Trends, 45 (4)*.

[34] Honebein PC. Duffy T M., Fishman BJ. (1993). Constructivism and the design of learning environments: context and authentic activities for learning. In: Duff TM., Lowyck J, Jonassen DH, editors. Designing environments for constructivism learning. Berlin: Springer-Verlag, pp. 87-108.

[35] Janee, G. and Frew, J. (2002). The ADEPT Digital Library Architecture. *In ACM/IEEE Joint Conference on Digital Libraries* (JCDL'02), (Portland, Oregon (July 14-18), 2009) ACM Press, 342-349.

[36] Jarvelin, K., & Ingwersen, P. (2004). Information seeking research needs extension towards tasks and technology. *Information Research, 10* (1).

[37] Jayawardana C., K. P. Hewagamage and M. Hirakawa. (2000). Virtual authoring based on the sallow copy technique for a collection of digital documents. *In Proceedings International Symposium on Multimedia Software Engineering*. Los Alamitos: The IEEE Computer Society.

[38] Jayawardana C., K. P. Hewagamage and M. Hirakawa. (2001). Database Systems Lab, Graduate School of Information Engineering, Hiroshima University. *MC Journal of Academic Media Librarianship*, v.8#1, summer 2001.

[39] Jose, J. M., Braddick, H. Martin, I., Robertson, B., Walker, C., & Macpherson, G. (2002). Virtual tutor: A system for deploying digital libraries. In E. P. Lim, S. Foo, C. Khoo, H. Chen, E. Fox, S. Urs & T. Costantino (Eds.), *Proceedings of 5th International Conference on Asian Digital Libraries* (pp. 275-286). Germany, Springer.

[40] Kaster L, Kirschner PA. Van Merriënboer JJG, Baumer A. (2001). Just-in-time information presentation and the acquisition of complex cognitive skills. *Comput Human Behav*. 17: 373-91.

[41] Kearsley, G.(2000). Learning and teaching in cyberspace. Canada: Wadsworth.

[42] Kirschner PA. (2002). Cognitive load theory: implications of cognitive load theory on the design of learning. Learn. Instr. 12: 1-10.

[43] Kolb (1984). In Ramakanta Sahu (2008). An Introduction to Education. (1st Ed) Yemen, Sana'a, Awan Publishers.

[44] Kozma, R. B. (1994). The influence of media on learning: The debate continues. School Library Media Quarterly, 22 (4), 233-240.

[45] Kuhlthau, C. C. (1993). Seeking meaning A process approach to library and information services. New Jersey: Ablex Publishing Corporation, Norwood.

[46] Large, A.; Beheshti, J.; Breuleux, A.; & Renaud, A. (1994a). A comparison of information retrieval from print and CD-ROM versions of an encyclopedia by elementary school students. *Information Processing & Management*, 30 (4), 499-513.

[47] Large, A.; Beheshti, J.; Breuleux, A.; & Renaud, A. (1994b). Multimedia and comprehension: A cognitive study. *Journal of the American Society for Information Science*, 45 (7), 515-528.

[48] Larkin JH, Simon HA. (1987). Why a diagram is (sometimes) worth ten thousand words. Cogn Sci. 11: 65-99.

[49] Lawalter D. (2003). Cognitive strategies for learning from static and dynamic visual. Learn Instr. 13: 177-89.

[50] Liebscher, P., & Marcionini, G. (1988). Browse and analytical search strategies in a fulltext CD-ROM encyclopedia. *School Library Media Quarterly*, 16 (4), 223-233.

[51] Limberg, L., Boras, H. I., & Boras. (1999). Experiencing information seeking and learning: A study of the interaction between two phenomenon. Information Resaerch, 5 (1).

[52] Logue, S. (2003). The changing role of libraries in instructional upport. *Information Technology and libraries*, 22 (2), 52.

[53] M. A. Goncalves (2004). Streams, Structures, Spaces, Scenarios, and Societies (5S): A formal digital library framework and its applications, Computer Service Doctoral Dissertation. Blacksburg, VA: Virginia Tech, 2004, 161 pages. http://scholar.lib.vt.edu/these/available/etd-1205-2004-135923/unrestricted/MarcoDissertation.pdf

[54] M. A. Gopinath (1996). Development of a curriculum for digital information systems: A learning package for library and information professionals. *SIS-96*, 18-20, '96, Bangalore.

[55] M. S. Sridhar (1996). Beware of electronic libraries/media. *SIS-96*, 18-20, '96, Bangalore.

[56] MacDonald, J. and Mason, R. (1999). Information handling skills and resource-based learning. Institute of Education Technology, The Open University (UK).

[57] Marchionini, G. (1989a). Information seeking strategies of novices using a full-text electronic encyclopedia. *Journal of the American Society for Information Science, 40 (1)*, 54-66.

[58] Marchionini, G. (1995). Information seeking in electronic environment. Cambridge University Press.

[59] Marlion, M., Summer, T. R., Fulker, D., Manduce, C. and Mogk, D. The digital library for Earth system education: building community, building the library. Communication of the ACM, Special Issue on Digital Libraries (May). 80-81.

[60] Mayer, RE, and Moreno, R. (2002) Aids to combuter-based multimedia learning. Learn. Instr., 12. 107-119.

[61] McNally, M. J. & Kuhlthau, C. C. (1994). Search process in science education. Reference Library, 44 (1), 53-60.

[62] Microsoft (2003). Microsoft's case study on IVLE. Retrieved October 2, 2003, from Microsoft's in Education on the World Wide Web: http://www.bpghs.wizlearn.net/public/case-study.html.

[63] Mylonas, E. (1992). An interface to classical Greek civilization. *J. Am. Soc. Inf. Sci. 43(2)*, 192-201.

[64] Natalie Lee-San Pang (2005). Digital libraries as learning environments for Youths. INFOSCI.

[65] Neuman, D. (1993). Designing databases as tools for higher-level learning: Insights from instructional systems design. Educational Technology Research and Development, 41 (4), 25-46.

[66] Neuman, D. (1995a). High school students' use of databases: Competing conceptual structures. Unpublished paper presented at the Annual Meeting of the American Society for International Science, Chicago.

[67] Neuman, D. (1995b). High school students' use of databases: Results of a national Delphi study. *Journal of the American Society for International Science*, 46 (4), 284-298.

[68] Oldyzko, A. M. (1994). Tragic loser good riddance? *The impending demise of traditional scholarly journal.* Notice of the AMS.

[69] Park, I. & Hannafin, M. J. (1993). Empirically based guidelines for the design of interactive multimedia. Educational Technology Research and Development, 41 (3), 63-85.

[70] Perkings, D. N. (1991). What constructivism demands of the learner. Educational Technology, 31 (9), 19-21.

[71] Perzylo, L., & Oliver, R. (1992). An investigation of children's use of a multimedia CD-ROM product for information retrieval. Microcomputers for Information Management, 9 (4), 225-239.

[72] Rapp, D. N., Taylor, H. A. and Grane, G. R. The impact of digital libraries on cognitive processes: psychological issue of hypermedia. Computers in Human Behavior, 19, 609-628.

[73] Renninger, K. A. and Shumar, W. (2002). Community building with and for teachers at the Math Forum. In Renninger, K. A. and Shumar, W. eds. Building virtual communities: Learning and change in cyberspace, Cambridge University Press, New York, 60-95.

[74] Rieber, L. P. (1990). Using computer animated graphics in science instruction with children. Journal of Educational Psychology, 82, 135-140.

[75] Rieber, L. P. (1996). Computer-based microworlds: A bridge between constructivism and direct instruction. Educational Technology Research & Development, 40 (1), 93-106.

[76] Santa Monica, Calif. (1994). Getty Art History Information Program, The American Council of Learned Societies, and The Coalition for Networked Information. Humanities and Arts on the Information Highway: A profile. Getty Art History Information Program.

[77] Scardamalia, M.; Berreiter, C.; Brett, C.; Burtis, P. J.; Calhoun, C.; & Smith, L. N. (1992). Educational applications of a networked communal database. Interactive Learning Environments, 2 (1), 45-71.

[78] Scardamalia, M.; Berreiter, C.; McLean, R.; Swalow, J.; & Woodruff, E. (1989). Computer-supported international learning environments. *Journal of Educational Computing Research*, 5, 51-68.

[79] Schaffner, A. (1994). The future of scientific journals: Lessons from the past. *Inf. Technol. Libr. 13(4)*, 239-247.

[80] Schnotz, W. (2002). Towards an integrated view of learning from text and visual displays. Educ. Pschol. 14, 20-101.

[81] Shenton, A. K., & Dixon, P. (2003). Models of young people's information seeking. *Journal of Librarianship and Information Science*, 35 (1), March.

[82] Shenton, A. K., & Dixon, P. (2004). Issues arising from youngest' information-seeking behavior. *Library and Information Science Research*, 26, 177-200.

[83] Small, R. V., & Ferreira, S. M. (1994). Multimedia technology and the changing nature of research in the school library. Reference Librarian, 44, 95-106.

[84] Smeaton, A. F., & Callan, J. (2005). Personalization and recommender systems in digital libraries. *International Journal on Digital Libraries*, 5 (4), 299-308.

[85] Smeaton, A., & Callan, J. (2002). Joint delos-nsf workshop on personalization and recommender systems in digital libraries (No. April 21).

[86] Smith, D. A. A., R. J., J. P. (1993). Misconceptions reconceived: A constructivist analysis of knowledge in transition. Journal of the Learning Sciences, 3 (2).

[87] Soloman, P. (1993). Children's information retrieval behavior: A case analysis of an OPAC. *Journal of the American Society for Information Science*, 44 (5), 245-263.

[88] Soloman, P. (1994). Children, technology, and instruction: A case study of elementary school children using an online public access catalog (OPAC). School Library Media Quarterly, 23 (1), 43-53.

[89] Soloway, E., Guzdial, M., & Hay, K. E. (1994, April). Learner-centered design: The challenge for HCI in the 1st Century. Interaction, 36-48.

[90] Stevens, C. (1993). Knowledge-based assistance for handling large, poorly structured information spaces. Ph.D. dissertation Univ. of Colorado at Boulder. Teac. Rep. CU-CS-640-93.

[91] Sue Roberts (2006). Partner or Pariah? : Future roles for libraries in learning and teaching. Ticer International Summer School 'Digital Librarie a/a Carte' 21-25.

[92] Sweller J, Van Merriënboer JJG, Pass FGWC. (1998). Cognitive architecture and instructional design. Educ Psychol Rev. 1998; 10: 251-96. August 2009. Available in URL: www.ticer.nl/06carte/publicat/13Roberts.pdf.

[93] Tosey, P., & Gregory, J. (1998). The peer learning community in higher education: Reflections on practice. *Innovations in Education and Training International, 35(1)*, 74-81.

[94] Vakkari, P. (2000). Relevance and contributing information types of searced documents in task performance. In Proceedings of the 23rd annual International

ACM SIGIR Conference on Research and Development in Information Retrieval. Athens, Greece; ACM Press.

[95] Vakkari, P. (2001). A theory of the task based information retrieval process: A summary and generalization of a longitudinal study. *Journal of Documentation,* 57 (1), 44-60.

[96] Wallace, R., Soloway, E., Krajcik, J., Bos, N., Hoffman, J., Hunter, H. E., et al. (1998). Artemis: Learner-centered design of an information seeking environment for k-12 education. In Chi pp. 195-202. Los Angeles, CA, USA.

[97] Watson, J. S. (1998). "If you don't have it, you can't find it." A close look at student's perceptions of using technology. *Journal of American Society for information Science*, 49 (11), 1024-1036.

[98] Wilmsen T, Hartog R, Bisseling T. (2002). Web based learning support for experimental design in molecular biology: a top-down approach. *Journal of Interactive Learning Research.* 14: 301-14.

[99] Wilson, T. (1999). Models in information behavior research. *Journal of documentation,* 55 (3), 249-270.

CHAPTER 4

METHODOLOGY

The main objective of this research project was to assess the techniques of Digital Libraries. The previous three chapters have discussed a detailed review of the related literature, the conceptual framework and important research questions. This chapter will describe the methodology adopted for carrying out the whole procedure of research. It will describe the variables, the tools used, procedure of data collection and statistical analyses.

4.1 A BRIEF DESCRIPTION OF VARIABLES OF THE PRESENT STUDY

Due to the amount and great variety of information stored, DLs have become one of the major Web services (Liaw & Huang, 2003[8]). Thereforere, as literature suggests, evaluation of DLs should be capable to capture a panoramic view of learners' opinions, able to take into account their characteristics grounded on their perceptions and goals. Thus for achieving the objectives of this research, A Model of Learning for Digital Library was used, which is a theoretical model that attempts to integrate knowledge and experience from the field of education, field of personalized information environment, and field of human-computer interaction. This model consists of two components, which are defined as Usability and Learning activities, and each of them is a resultant of a number of attributes and activities respectively that are considered as evaluation variables (see Figure (4.1.1)) which is translated to the Figure (4.1.2) to simplify the research idea. The following subsets present analytically the evaluation axes and their components attributes and activities.

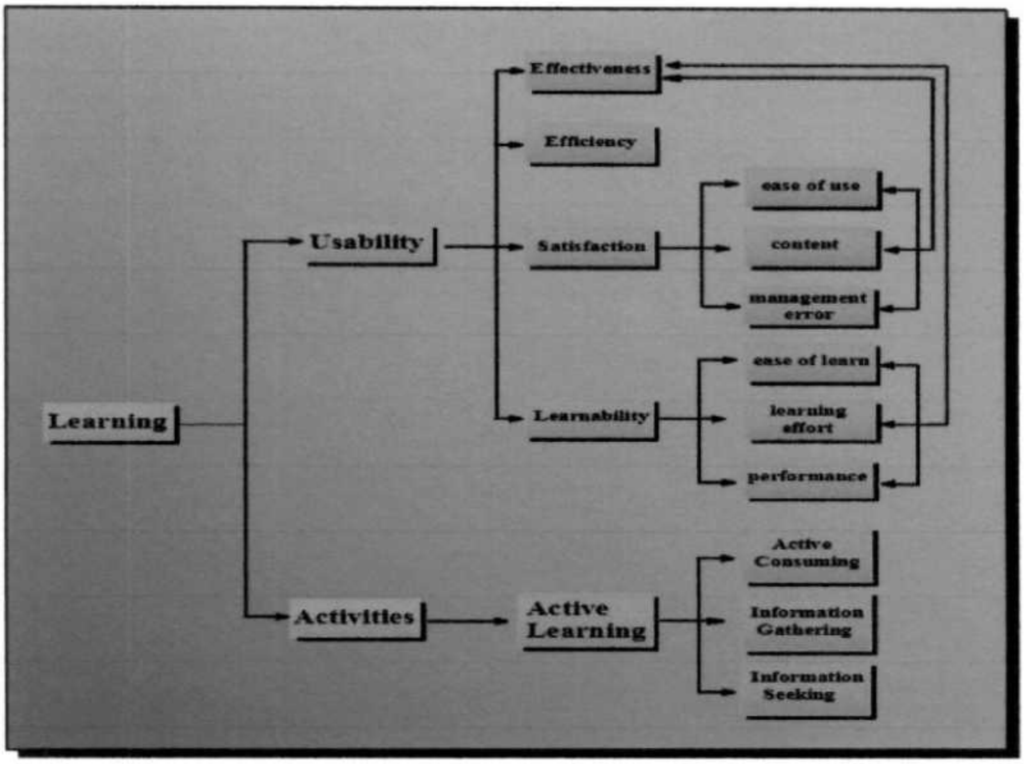


Figure (4.1.1) Model of Learning for Digital Library developed by the researcher

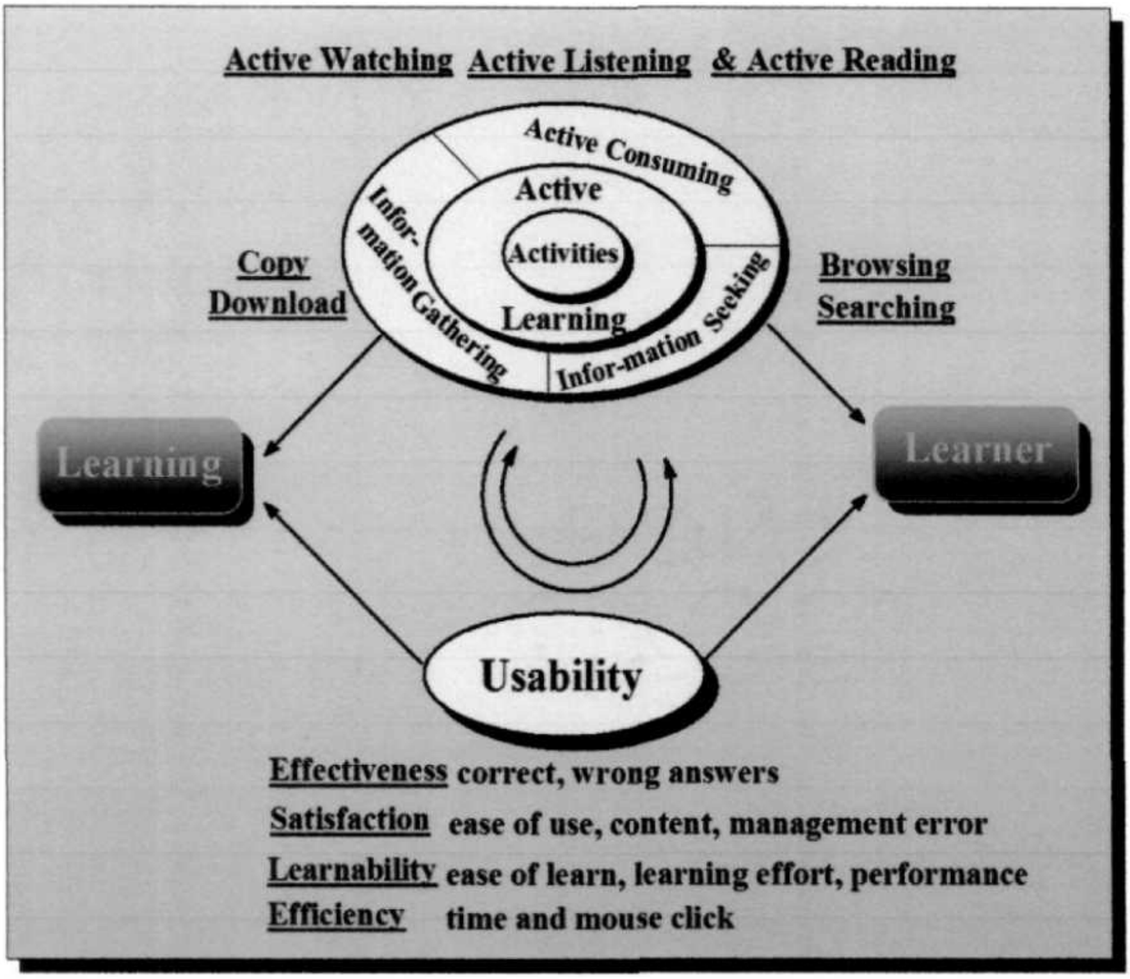


Figure (4.1.2) Model of Learning for Digital Library

4.1.1 ACTIVITIES RELATED TO LEARNER (ACTIVE LEARNING)

Learning is a process of knowledge construction in which the learner carries out many activities (Lorenzen, 2001[9] and Fitzgerald, 1998[2]). Active learning can be described as the ability of learners to carry out the activities effectively and efficiently while incorporating them into a process of their own education. In active learning, learners take responsibility for their own education and study strategies to accomplish their academic goals (Lee, 1999[7]). With respect to digital materials, three actions create the tools for active learning (Active consuming, Information Gathering, and Information Seeking). Active Consuming is carrying out activities effectively with respect to different media types. These include active reading, active listening, and active watching. Constructing the user's reference collection with ease is the main concept of the information-gathering portion such as copy, download, etc. To provide intelligent support in a digital learning environment, information-seeking facilities are needed to locate suitable materials such as searching and browsing in our study. Therefore, activities (active learning) stands on learner-learning axis, focuses on active consuming, information-gathering, and information-seeking tasks accomplishment and aim to support interaction between the learner and learning.

4.1.2 USABILITY OF THE TOOL (COMPUTER) IN TERMS OF EFFECTIVENESS, EFFICIENCY & LEARNABILITY

Usability stands on the learner-learning axis, focuses on the effective, efficient, and satisfactory task accomplishment and aims to support a normal and uninterrupted interaction between the learner and the learning. DL community has shown an increasing interest in usability and through the research activities a set of attributes have been identified such as ease of use, content, management error, ease of learn, learning effort, and performance. Previous studies such as Judy Jeng (2005a[3], 2005b[4]) focused on developing and evaluating methods and instruments for assessing the digital libraries. It was found that there existed an interlocking relationship among effectiveness, efficiency, and satisfaction. It provided operational criteria for effectiveness, efficiency, satisfaction, and learnability. It discovered users' criteria on "ease of use," "organization of information," "terminology and labeling," "visual attractiveness," and "mistake recovery". Learnability describes how easy is it for the users to accomplish basic tasks the first time they encounter the design (Nielsen, 2003[12]). This learnability consists of three factors in the present study which are, ease of learn, learning effort, and performance. Satisfaction is an important factor of this study that means the pleasantness in the use of the site as well as the way efficiency and the user (Ferrira and Pithan, 2005[15]) perceived effectiveness of the system.

4.2 POPULATION AND SAMPLE

In this research, the population comprised of Taiz University Learners (English Language Teaching Background) using different materials of Berkeley Digital Library.

As Taiz University Learners who have English Language and Web background are very limited, so a sample of only 50 learners could be selected by incidental sampling method.

All of them had enough knowledge of Internet, and had used and searched Internet before this research. However, they had no idea of using digital libraries web sites. Therefore, they were trained for about two months to use BDL web site correctly for browsing, searching, navigating, using different multimedia software, and looking for important information etc.

4.3 TOOLS USED

In order to collect data the following tools were used.

I A questionnaire constructed on digital library materials by the investigator. This questionnaire consisted of three parts: First part was based on Web-based experience, which consisted of six (06) questions. Second part concentrated on usability and learning activities. This part consisted of nine (09) main questions. Third part consisted of thirteen (13) questions and concentrated on the usability attributes (Appendix A). *Reliability and Validity of the instrument are discussed in the next sections (4.6, 4.7).* (For Normality, see Appendix F & Appendix B for Reliability and Appendix D for Factor Loading).

II Interviews from the subjects on digital library were also conducted by the investigator, which helped the investigator to infer learners' attitudes and motivation. This interview consisted of three questions, the first concentrating on learners' need, second concentrating on the learning activities available and the third question concentrating on the importance of the digital library in English language subject.

III A test of learnability was also used, which consisted of thirteen (13) questions, concentrating on the ability of students to use the system easily and rapidly (Appendix E).

4.4 RELIABILITY OF THE INSTRUMENT

A measurement instrument is considered to have a high degree of reliability when it is consistent and accurate (Mueller, 1986[11]). The reliability of the instrument used in this study was assessed by using Cronbach's alpha coefficient of consistency. It was considerably high with a value of 0.921 with eighty-four items (see Appendix B).

Table (4.4.1) Cronbach's alpha coefficient

Cronbach's Alpha	*Cronbach's Alpha Based on Standardized Items*	*No. of Items*
.921	.844	84

4.5 VALIDITY OF THE INSTRUMENT

The validity of an instrument refers to whether it measures what it is supposed to measure (Mueller, 1986[11]). The content validity was established by careful selection of scale items, and by submitting the questionnaires to a panel of experts in the field of educational technology and research and evaluation to make sure that the questionnaires items are qualified to measure the perception towards Learning assessment of digital library techniques: Usability, Effectiveness, Efficiency, Satisfaction, and Learnability of the students of English Language Teaching. Then, the questionnaires were revised based on the suggestions and comments from the panel members. The researcher also modified some items of the questionnaires of the pilot study.

4.6 THE VALIDITY OF INSTRUMENTS (FACTOR EXTRACTION)

There are various ways to check the validity of instruments, such as by determining how many factors to extract. Therefore, many researchers rely on the Kaiser rule of extraction that is the default option in most statistics packages including SPSS (Thompson & Daniel, 1996[17]). However, the researcher checked the validity of the instrument upon finding the study using the Principal Component factor analysis, defined as follows:

A factor extraction method was used to form uncorrelated linear combinations of the observed variables. The first component had maximum variance. Hence, successive components explained progressively smaller portions of the variance and were all uncorrelated with each other. The principal component analysis was used to obtain the initial factor solution. The factor analysis procedure, as shown in Appendix D, indicated that all the 84 items of the questionnaire loaded heavily on three factors that explain 89.756% of the variance. The result showed that the first factor alone explained 18.757% of the total variance. Finally, the principal procedure of component factor analysis by using varimax rotation was conducted on the real data that provided two conditions: i) the number of factors extracted were seventeen and, ii) coefficients were supported. (Tabachnich & Fidell, 1996[16]). The factor analysis procedure, as shown in Table 4.6.1 indicated that the seventeen factors extracted explained 89.756% of the total variance (See Appendixes A-F for more details).

Table (4.6.1) Factors Loading

Total Variance Explained

Component	Initial Eigen values			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	15.944	18.757	18.757	11.929	14.034	14.034
2	15.152	17.825	36.583	9.843	11.580	25.614
3	9.940	11.694	48.276	9.010	10.600	36.214
4	6.762	7.956	56.232	7.610	8.953	45.168
5	4.605	5.418	61.650	5.381	6.331	51.499
6	3.293	3.874	65.524	4.881	5.742	57.241
7	3.175	3.736	69.260	4.165	4.900	62.141
8	2.595	3.053	72.312	3.709	4.364	66.505
9	2.329	2.740	75.053	3.267	3.844	70.349
10	2.309	2.716	77.769	2.960	3.483	73.832
11	1.883	2.215	79.984	2.480	2.918	76.750
12	1.822	2.144	82.128	2.354	2.769	79.518
13	1.729	2.034	84.162	2.018	2.374	81.892
24	1.398	1.645	85.807	1.786	2.101	83.993
15	1.192	1.403	87.209	1.722	2.026	86.019
16	1.114	1.310	88.519	1.600	1.882	87.901
17	1.051	1.237	89.756	1.577	1.855	89.756
18	.915	1.077	90.833			

The Screen Plot figure ensures seventeen factors as shown in the Figure (4.6.1) below

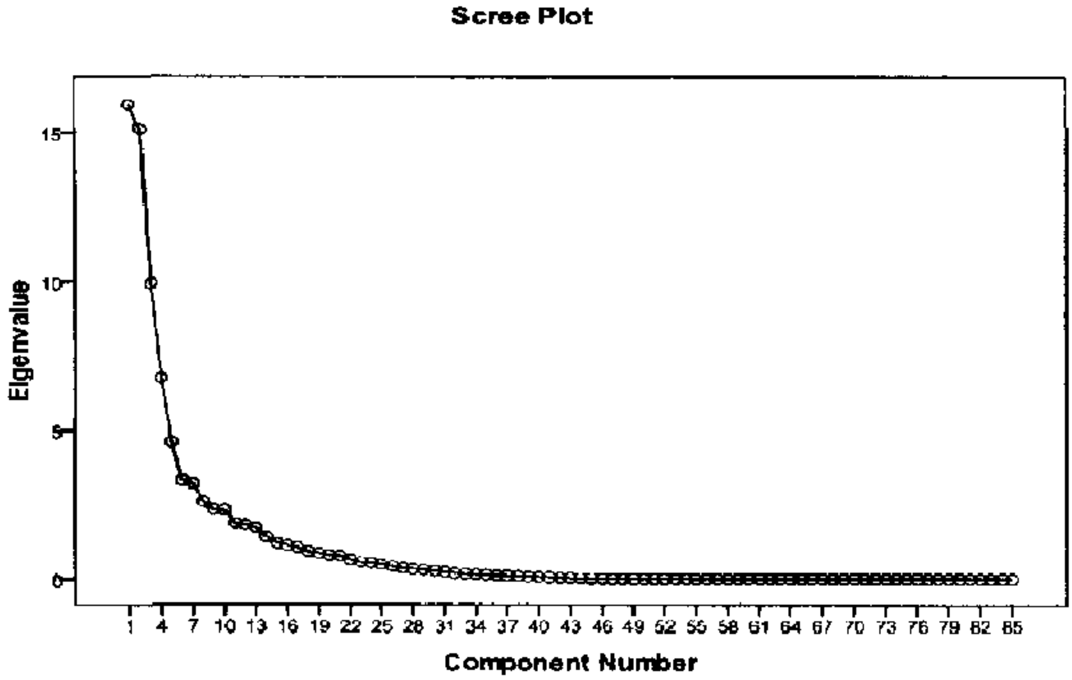


Figure (4.6.1) Screen Plot

4.7 PROCEDURES (DATA COLLECTION)

For the purpose of the data collection, the investigator approached each learner who had English Language and Web background or at least had experience of searching of Web personally and persuaded the learners to supply necessary information collectively and frankly. The Berkeley Digital Library was selected to be evaluated for its materials (http://www.berkeley.edu/) to fulfill the study objectives.

Figure (4.7.1) screen shot of main Web page of the Berkeley Digital Library

There are two reasons for selecting Berkeley Digital Library for assessment. First, it is based on the teaching, learning and research needs and it provides access to items of broad research value. It does not have much general level search, browsing and help mechanisms, and does not have these mechanisms at individual level. See Figures (4.7.2, 4.7.3,) as shown below:

Figure (4.7.2) Berkeley Course Web Page

Figure (4.7.3) Berkeley with navigation

Secondly, it has a variety of software such as iTunes, QuickTime, and You Tube programs that facilitate the download of different media in short time with high speed. See Figures (4.7.4, 4.7.5, 4.7.6, 4.7.7) as follow:

Figure (4.7.4) screen shot of Berkeley iTunes software download

Figure (4.7.5) screen shot of QuickTime download

Figure (4.7.6) screen shot of Berkeley media course collection

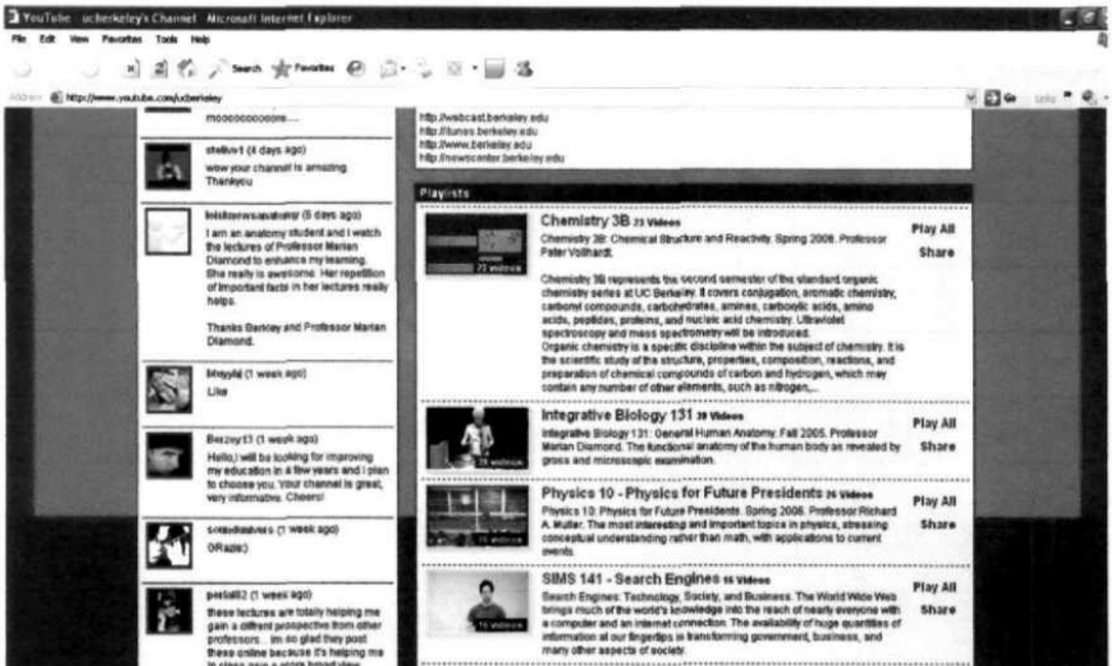


Figure (4.7.7) screen shot of different media with different subjects

The data collection procedures were as follows: first, subjects were instructed to find information about English, Geography, Philosophy, etc. question number 2, and 3. and in another question (e.g. number 1) subjects were instructed to find a text titled "different places, different people" and so on. Secondly, the students were instructed to rate the importance of the digital library through a close-ended questionnaire. They were asked to use different scale for different questions for rating, some from 1-5 and other using negative and positive answers (No/Yes) in which 1=No and 2=Yes. Before questioning started, the investigator copied around fifty papers in different subjects and downloaded hundred audios and hundred videos in different subjects. See Figures (4.7.8, 4.7.9).

Figure (4.7.8) screen shot of Audio collections

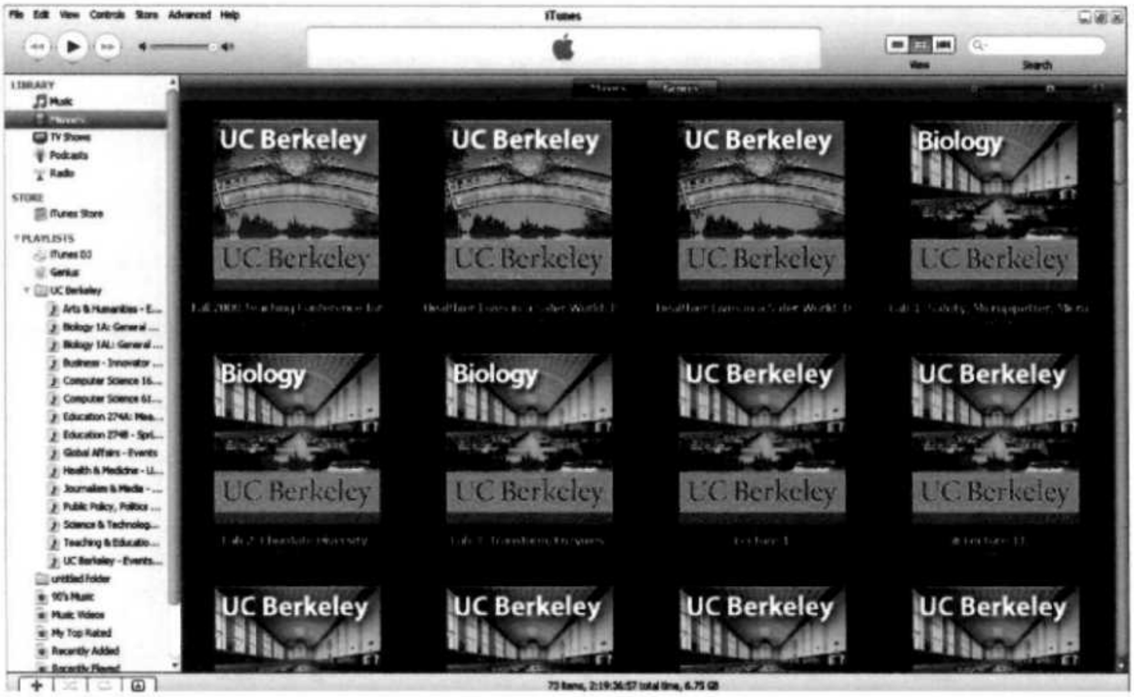


Figure (4.7.9) screen shoot of Video collections

4.8 STATISTICAL ANALYSES

The researcher used SPSS program for statistical purposes and used convenience techniques such as descriptive statistics (including means and standard deviation) and inferential statistics (such as multiple regression). Multiple regression technique with the backward method brought the results such as the correlation coefficient between two variables (R), the coefficient of determination (R^2), and the estimated coefficient of determination (adjusted R^2). ANOVA with F-value and F-Sig- value of the model and coefficients results such as B, β, t-value, and t-Sig-value were also calculated.

Moreover, AMOS 5.0 Graphics was used to run the structural model and test the hypothesized relationships between the constructs. Maximum likelihood estimation was employed to compute structure coefficients between latent variables. Chi-square (X^2), Chi-square X^2/df, Goodness-of-Fit (GFI), Adjusted Goodness of Fit (AGFI), Comparative Fit Index (CFI), Root Mean Square Residual (RMR), and Root Mean Square Error of Approximation (RMSEA) were used to evaluate model fit (Joreskog & Sorbom, 1996[5]; Meyers, Gamst, & Guarino, 2006[10]). In addition, causal paths were interpreted as standardized coefficients in a regression analysis. Predictive power was examined with multiple correlations (R^2) for each endogenous variable.

REFERENCES

[1] Adams, A., & Blandford, A. (2002). Digital libraries in academia: Challenges and changing. *In Proceedings of the Fifth International Conference on Asian Digital Libraries* (ICADL 2000) (pp. 392-403).

[2] Fitzgerald, M. (1998). *Information, Knowledge and Learning: The Library in the Digital Age*. Report prepared for the Marc Fresko Consultancy. http://ukoln.ac.uk/services/papers/bl/blri078/content/repor~20.htm

[3] Jeng, J. (2005a). Usability assessment of academic digital libraries: Effectiveness, Efficiency, Satisfaction, and Learnability. *LIBRI, 55(2-3)*, 96-121.

[4] Jeng, J. (2005b). What is usability in the context of digital library and how can it be measured? *Information Technology and Libraries 24(2)*, 47-56.

[5] Joreskog, K. G., & Sorbom, D. (1996). LISREL 8 User's Reference Guide. Chicago: Scientific Software International.

[6] Landau Sabine & Everitt Brian (2004). *A handbook of statistical analyses using SPSS.* USA, Florida, Chapman & Hall/ CRC Press LLC.

[7] Lee, J. (1999). Interactive learning with a Web-based digital library system. Prepared for the Ninth DELOS Workshop on Digital Libraries for Distance Learning. http://courses.cs.vt.edu/~cs3604/DELOS.html

[8] Liaw, S. S., & Huang, H. M. (2003). An investigation of user attitudes toward search engines as an information retrieval tool. *Computer in Human Behavior, 19*, 751-765.

[9] Lorenzen, M. (2001). Active learning and library instruction. Michigan State University. http://www.libraryreference.org/activebi.html

[10] Meyers, L., S., Gamst, G., & Guarino, A. J. (2006). Applied Multivariate Research: Design and Interpretation. Thousand Oaks, CA: Sage Publication, Inc.

[11] Mueller, D. (1986). *Measuring social attitudes: A handbook far researchers and practitioners.* New York, NY: Teacher College Press.

[12] Nielsen (2003). Usability 101: Introduction to usability. Useit.com: Usable Information Technology. Use Net Alterbox, August. Disponivel em: http://www.useit.com/alterbox/20030825.html.

[13] Owen, C., G., Sunderraman, R., Zhang, Y. (2000). *The development of a digital library to support the teaching of computer graphics and visualization*. Computer & Graphics 24(4): 623-627.

[14] Stelmaszewska, H., & Blandford, A. (2004). From physical to digital: A case study of computer scientists' behavior in physical libraries. *International Journal on Digital Libraries, 4(2)*, 82-92.

[15] Sueil Mara Ferreira, Denise Nunes Pithan (2005). Usability of digital libraries: a study based on the areas of information science and human-computer-interaction. IFLA General Conference and Council, Oslo, Norway.

[16] Tabachnick, B. & Fidell, L. (1996). *Using multivariate statistics*. New York, NY: Harper Collins College Publishers.

[17] Thompson, B. & Daniel, L. (1996). Factor analytic evidence for the construct validity of scores: A historical overview and some guidelines. *Educational and Psychological Measurement, 56(2)*, 197-208.

[18] Vijay Gupta (1999). SPSS for Beginners. (1st Ed.), VJBooks Inc.

[19] Hair JF, Anderson RE, Tatham RL, Black WC (1992). Multivariate Data Analysis with Readings. New York: MacMillan.

CHAPTER 5

RESULTS, INTERPRETATION AND DISCUSSION

5.1 RESULTS AND INTERPRETATION

To answer the research questions and to test the hypotheses of this study, the researcher has used several statistical techniques as mentioned in the previous chapter, (chapter 4). By using AMOS 5.0 Graphics program, estimates of squared multiple correlations, overview of structural equation modeling (SEM), structural equation modeling (SEM) analysis, overall Goodness-of-Fit statistics, and overall Goodness-of-Fit of the Model have also been presented. For the sake of convenience of presentation the entire chapter has been divided into three sections:

Section I: Study of various variables by using multiple regressions.

Section II: Analysis of the Structural Model by using AMOS 5.

Section III: Analysis of the Students' Comments.

SECTION I: STUDY OF VARIOUS VARIABLES BY USING MULTIPLE REGRESSION

Table (5.1.1) Summary of all variables: Values of R, R^2, and Adjusted R square

Model	*R*	*R Square*	*Adjusted R Square*
1	.835	.698	.656
2	.462	.214	.060
3	.639	.409	.342
4	.563	.317	.256
5	.711	.506	.474
6	.892	.795	.742
7	.974	.948	.944
8	.823	.678	.649
9	.291	.085	-.019
10	.711	.506	.474
11	.219	.048	-.060
12	.230	.053	-.054
23	.639	.409	.342
14	.395	.156	.120
15	.647	.419	.367
16	.755	.570	.510
17	.617	.381	.341
18	.247	.061	.041

The table (5.1.1) above indicates the correlation coefficient R, coefficient of determination R^2, and the estimated coefficient of determination Adjusted R Square. It may be noted that the correlation coefficient was highest between "***students' experience***" and "***Internet variables***" (R=0.974) (Model number 7 above). The correlation coefficient between "***usability***" and "***satisfaction***" was found to be R=0.892 (Model No. 6 above).

The detailed analysis of the latent variables under usability showed that the correlation in between "***effectiveness***", "***efficiency***" and "***satisfaction***" (for reading text) was R=0.835 (Model No. 1).

Moreover, the correlation between "***learnability***" and "***ease of learn***" was found to be very high (R=0.823) (Model No. 8). However, "***learning activities***" and "***satisfaction***" (for listening to audio), showed a correlation value, R=0.755 (Model No. 16). The value of correlation between "***time spent***" for reading text and "***satisfaction***" came to be R=0.711 (Model No. 5). The same value was obtained for a correlation between "***efficiency***" in reading text and "***satisfaction***" (Model No. 10).

So far as video watching activity is concerned, the value of correlation between "***learning activities***" and "***satisfaction***" was, R=0.647 (Model No. 15). The correlation value for "***number of steps***" involved in video watching and "***satisfaction***" was reported to be, R=0.639 (Model No. 3), and finally, between "***learning activities***" and "***satisfaction***" for reading text was found to be, R=0.617 (Model No. 17).

Table (5.1.1a). Correlation Matrix

	Effectiveness	Efficiency Time	Efficiency Steps	Satisfaction	Learnability	Active Consuming	Information Gathering	Information Seeking
Effectiveness	1	.889 **	-.880**	.681**	.619**	.560**	.992**	.922**
Efficiency Time		1	-.669**	.486*	-.645**	-.559**	.716**	-.758**
Efficiency Steps			1	.718**	.822**	.831**	-.819**	-.622**
Satisfaction				1	.782**	.948**	.563**	.537**
Learnability					1	-.717**	-.654**	-.590**
Active Consuming						1	.539**	.662**
Information Gathering							1	.887**
Information Seeking								1

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

It is noted that the variables in the correlation matrix highly correlate each other in two levels which are 0.01 (**) and 0.05 (*) as mentioned in table (5.1.1a).

Table (5.1.2) Analysis of Variance between variables

Model	*df*	*F*	*Sig.*	*Notes*
1	6	16.564	.000	*
2	8	1.394	.228	
3	5	6.086	.000	*
4	4	5.213	.002	**
5	3	15.718	.000	*
6	10	15.126	.000	*
7	4	207.119	.000	*
8	4	23.700	.000	*
9	5	.815	.546	
10	3	15.718	.000	*
11	5	.443	.816	
12	5	.494	.779	
13	5	6.086	.000	*
14	2	4.353	.018	***
15	4	8.111	.000	*
16	6	9.496	.000	*
17	3	9.439	.000	*
18	1	3.107	.084	

*=P<.001, **=P<.01, and ***=P<.05 indicate the significance level

Table (5.1.2) explained the results of ANOVA, which indicated the significance level associated with observed value F. The significance levels are expressed as *=P<.001, **=P<.01, and ***=P<.05.

All values were found significant except the following: "***efficiency***" & "***satisfaction2***" (listening audio), "***number of steps***" & "***satisfaction1***" (reading text), "***number of steps***", & "***satisfaction2***" (listening audio), "***time spent***" & "***satisfaction2***" (listening audio), and "***learning activities***" & "***ease of learn***" (reading text) see Figure (5.1) below.

The details of all significant relationships between the observed variables are presented in the following tables (table (5.1.3) to table (5.1.20)).

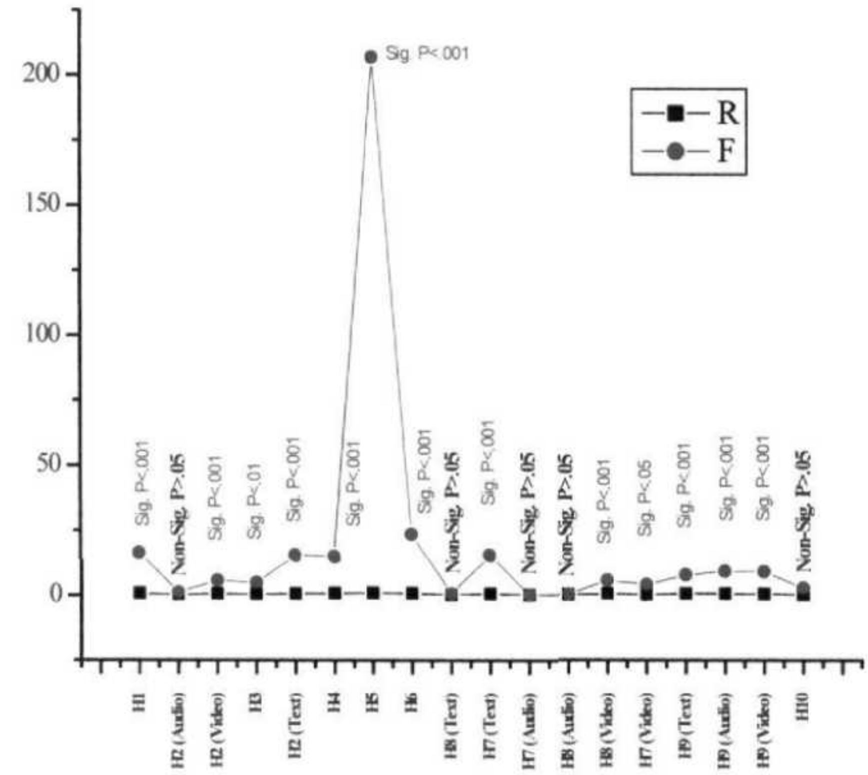


Figure (5.1) Summary R and F

1) RELATIONSHIP BETWEEN EFFECTIVENESS, EFFICIENCY, AND SATISFACTION (Q1)

Research Question No. 1: "Do the effectiveness and efficiency of using the digital library materials have influences on students' satisfaction?"

Hypothesis No. 1: "*The levels of effectiveness (of digital libraries) will have a significant impact on learner's efficiency and satisfaction.*"

Table (5.1.3) Relationship between effectiveness, efficiency, and satisfaction: unstandardized and standardized coefficients

Model		Unstandardized Coefficients	Standardized Coefficients		
		B	Beta	t	Sig.
1	(Constant)	3.809		6.758	.000(*)
	Dose the library have a paper copy of a-) Education History?	.594	.304	3.176	.003(**)
	c-) What use in economic theory?	-.910	-.435	-4.520	.000(*)
	EduTime	.265	.728	2.876	.006(**)
	HistoryofSocialTheoryTime	-.607	-1.305	-5.503	.000(*)
	TeachingEngtoWorldTime	.358	.962	4.251	.000(*)
	Mauseb	-.159	-.153	-1.777	.083

*=P<.001, **=P<.01, and ***=P<.05 indicate significance level.

Table (5.1.3) above indicated relationship between the dependent variable "***satisfaction1***" (reading text) with the predictors:

i. Does the library have a paper of the following education history? (t=3.176, P=.003),

ii. What use in economic theory (t=-4.520, P=.000),

iii. Time spent to reach the answer for education history (t=2.876, P=.006),

iv. Time spent to reach the answer for history of social theory (t=-5.503, P=.000),

v. Time spent to reach the answer for teaching English to the world (t=4.251, P=.000), and the results were found to be significant.

On the basis of above results, the hypothesis 1 was accepted that, "*The levels of effectiveness (of digital libraries) will have a significant impact on learner's efficiency and satisfaction.*" Inversely, the relationship between the "***number of steps***" to reach the answer for "does the library have a paper of different place, different people?" ($t=-1.777$, $P=.083$) was found to be non-significant.

Therefore, the researcher tested the prediction that asks, "If the library has a paper copy of education history …etc." The model was significant with $R=.835$, $R^2=.698$, F (6, 43) =16.564, $P<.001$. Its predictors such as:

i. Education history ($\beta=.304$, $P=.003$),

ii. What did economic theory use? ($\beta=-.435$, $P=.000$),

iii. Time spent for finding the education history ($\beta=.728$, $P=.006$),

iv. Time spent for history of social theory ($\beta=-1.305$, $P=.000$), and

v. Time spent for teaching English to the world ($\beta=.962$, $P=.000$), are the only significant predictors for the digital library's paper copy which is one type of the learning materials.

Thus, hypothesis 1 was supported by accounting for 69.8% of the variance for paper copies that are available in the digital library. After the hypothesis 1 was supported, the researcher decided to see if including other factors could increase the explanatory power of the model. Examination of the correlations between the predictors indicated a considerable negative correlation between various variables, (see Appendix A). Therefore, three regressions were run each including only one of the correlated predictions. First two regressions models were significant with the best model results.

In the first model, when the paper entitled different places, different people and the time as mentioned above were included, the values of $R=.711$, $R^2=.506$, F (3, 46) =15.718, $P=.000<.001$ were obtained. Predictors such as:

i. Time spent for answering what use in economic theory paper (β=.570, P=.013<.05),

ii. Time spent for answering the history of social theory (β=-.974, P=.001<.01), and

iii. Time spent for answering teaching English to the world (β=1.016, P=.000<.001) were significant predictors for efficiency of the digital library.

In the second significant model, all mentioned variables, except the "***time spent***" for answering, were found significant with values, R=.675, R^2=.455, F (3, 46)=12.804, P=.000<.001. Here, the predictors such as:

i. What did economic theory use? (β=-.260, P=.033<.05),

ii. Time spent for answering education history paper (β=.956, P=.001<.01), and

iii. Time spent for answering the paper entitled history of social theory (β=-.520, P=.045<.05) were marginally significant.

Finally, the "***number of steps***" to reach the answers, released the new model but unfortunately this model was not significant, with F (3, 46) =1.208, P=.318>.05. In other words, the "***effectiveness***" and "***efficiency***" of using the digital library materials have influences on the students' satisfaction (see Figure (5.1.1) below).

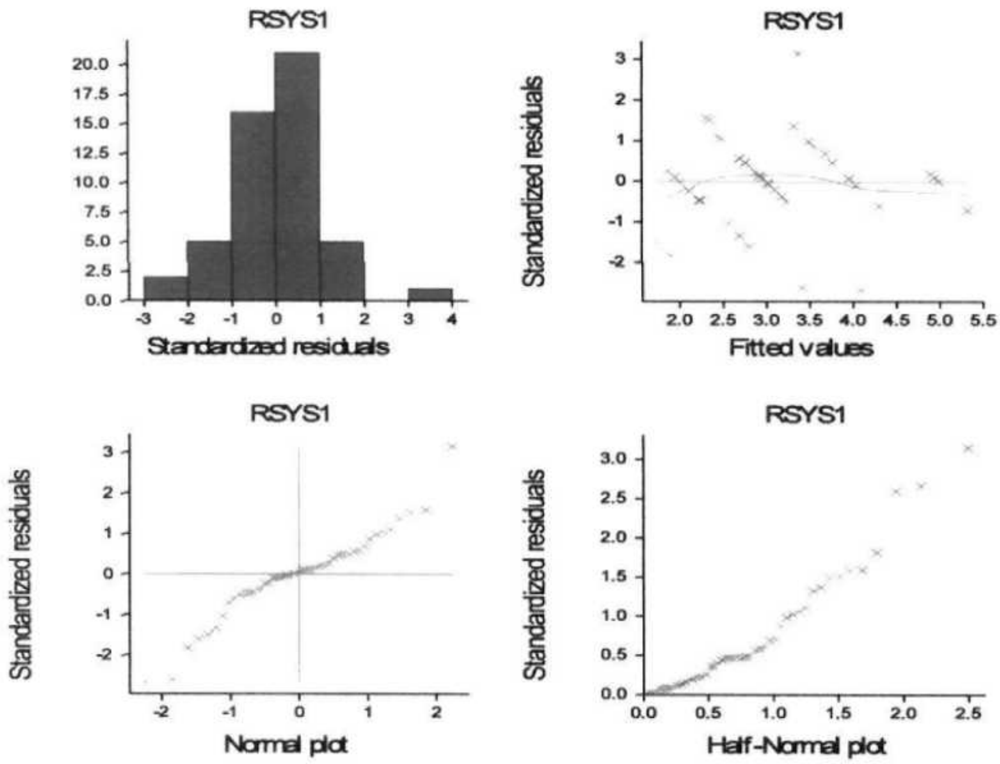


Figure (5.1.1, a) influence of effectiveness & efficiency on satisfaction

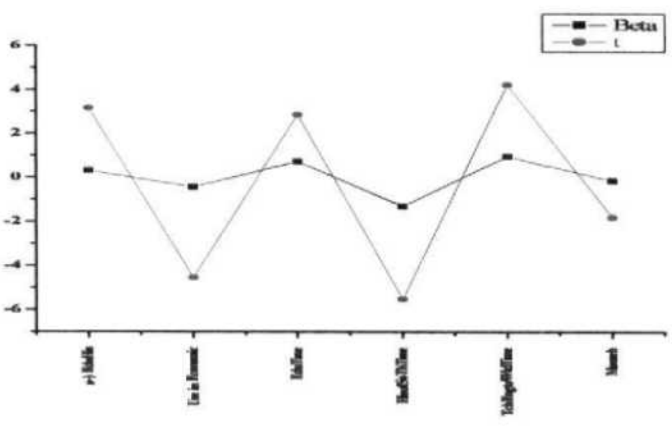


Figure (5.1.1, b) influence of effectiveness & efficiency on satisfaction

Influences of Effectiveness and Efficiency on satisfaction (H1)

This finding contributes to both confronting and expanding ways to seek knowledge as the "***effectiveness***" and "***efficiency***" influences on students' "***satisfaction***". A few empirical organizational studies also confirm that the "***effectiveness***" and "***efficiency***" have influence on students' "***satisfaction***", such as the work of Nielsen (1993)[46] discussed the efficiency and satisfaction as attributes of the usability, and Judy Jeng (2005a, 2005b) [30, 31] discussed the relationship among effectiveness, efficiency, and satisfaction. Thus, in the present research the results were positive and answered the research question (RQ1) "*Do the effectiveness and efficiency of using the digital library materials have influences on students' satisfaction?*" in affirmation.

The present finding emphasize that many factors influence upon students' "***satisfaction***" while using the digital library materials. The hypothesis 1 as shown in this chapter accounted for 69.8% of variance. Hence, it can be concluded that the students were satisfied with searching documents or papers that were available in BDL and did many tasks such as copying and reading these papers or e-books. These findings support Judy Jeng (2005a, 2005b) [30, 31] empirical results.

2) RELATIONSHIP BETWEEN EFFICIENCY AND SATISFACTION (Q2)

Research Question No. 2: Does the efficiency of using the digital library materials have influences on students' satisfaction?

Hypothesis No. 2: "*The levels of efficiency will have a significant impact on learner's satisfaction.*"

Table (5.1.4) Relationship between Efficiency and Satisfaction (Q2): Unstandardized and Standardized Coefficients

Model		Unstandardized Coefficients	Standardized Coefficients		
		B	Beta	t	Sig.
2	(Constant)	4.275		5.420	.000(*)
	Use a database to find an Audio about a-) English Subject	.937	1.123	2.214	.032(***)
	b-) Philosophy	.882	1.141	1.791	.081
	c-) History	-.461	-.734	-1.696	.098
	e-) Satistics	-1.634	-2.391	-2.667	.011(***)
	EnglishTime	.577	3.754	3.006	.004(**)
	HistoryTime	-.356	-2.112	-2.303	.026(***)
	GeographyTime	-.573	-3.388	-2.263	.029(***)
	StatisticsTime	.331	2.085	1.846	.072
a. Dependent Variable: Pleas, rank the ease of the System2					

*=P<.001, **=P<.01, and ***=P<.05 indicate significance level.

The relationships between the predictors such as:

i. Use a database to find an audio about statistics (t=-2.667, P=.011),

ii. Time spent for English subject (t=3.006, P=.004),

iii. Time spent for history audio (t=-2.303, P=.026),

iv. Time spent to reach the answer for geography audio (t=-2.263, P=.029),

and the dependent variable "***ease of use the system***" were found to be significant.

Therefore, the hypothesis 2 was accepted that, "*The levels of efficiency will have a significant impact on learner's satisfaction*".

Inversely, the predictors such as:

i. Use a database to find an audio about philosophy (t=1.791, P=.081).

ii. Use a database to find an audio about history (t=-1.696, P=.098),

iii. Time spent to reach the answer for "statistics question" (t=1.846, P=.072), were not significant.

3) RELATIONSHIP BETWEEN EFFICIENCY AND SATISFACTION (Q3)

Table (5.1.5). Relationship between Efficiency and Satisfaction (Q3): Unstandardized and standardized coefficients

Model		Unstandardized Coefficients	Standardized Coefficients		
		B	Beta	t	Sig.
3	(Constant)	.971		.897	.375
	b-) Organization of Body	1.466	1.569	4.719	.000(*)
	c-) Shell Programming	-1.831	-1.350	-3.812	.000(*)
	d-) Amines	-.356	-.423	-2.296	.026(***)
	e-) Atoms and Heart	1.711	1.320	4.857	.000(*)
	f-) General Psychology	-.661	-.691	-3.035	.004(**)

a. Dependent Variable: Please, rank the ease of the System3

*=P<.001, **=P<.01, and ***=P<.05 indicate significance level.

The relationships between the dependent variable "***satisfaction3***" (watching video) and the predictors such as:

i. Use a database to find a video about organization of body video (t=4.719, P=.000),

ii. Shell programming video (t=-3.812, P=.000),

iii. Amines video (t=-2.296, P=.026),

iv. Atoms and heart video (t=4.857, P=.000),and

v. General psychology video (t=-3.035, P=.004), were significant.

Therefore, the hypothesis 2 was accepted.

4) RELATIONSHIP BETWEEN EFFICIENCY AND SATISFACTION (Q4)

Table (5.1.6) Relationship between Efficiency and Satisfaction (Q4): Unstandardized and standardized coefficients

Model		Unstandardized Coefficients	Standardized Coefficients		
		B	Beta	t	Sig.
5	(Constant)	2.328		9.237	.000(*)
	EconomicTheoryTime	.235	.570	2.594	.013(***)
	HistoryofSocialTheoryTime	-.453	-.974	-3.433	.001(**)
	TeachingEngtoWorldTime	.378	1.016	4.261	.000(*)
a. Dependent Variable: Pleas, rank the ease of the System1					

*=P<.001, **=P<.01, and ***=P<.05 indicate significance level.

The predictors as shown in table (5.1.6) explained the relationship of "***efficiency***" (time category) with the dependent variable "***satisfaction1***" (reading text) – (efficiency in this study was measured by time spent and number of steps involved to reach the answer of a question.)

The relationships between the predictors such as:

i. Time spent to reach the answer for "does the library has a paper form of use in economic theory?" (t=2.594, P=.013),

ii. Time spent to reach the answer for "does the library have a paper of history of social theory?" (t=-3.433, P=.001), and

iii. Time spent to reach the answer for "does the library have a paper of teaching English to the world?" (t=4.261, P=.000), were significant.

Therefore, the hypothesis2 was accepted.

The hypothesis 2 explained the "***efficiency***" in using digital library materials in terms of the "***number of steps***" to reach answers and the time spent. Since there were three categories: paper, audio and video, therefore, three multiple regression techniques were used to analyse the relationships.

In the first multiple regression, the result was significant with R=.711, R^2=.506, F (3, 46) =15.718, P=.000<.001. The predictors namely:

i. Time spent for answering what use in economic theory paper (β=.570, P=.013<.05),

ii. Time for answering the history of social theory paper (β=-.974, P=.001<.01), and

iii. Time for teaching English to the world paper (β=1.016, P=.000<.001) were the only significant predictors.

In the second category, the result was unfortunately not significant, with R=.462, R^2=.214, F (8, 41) =1.394, and P=.228>.05. And the predictors namely,

i. English subject audio (β=1.123, P=.032<.05),

ii. Statistics audio (β=-2.391, P=.011<.05),

iii. Time spent for answering English subject audio (β=3.754, P=.004<.01),

iv. Time spent for answering history audio (β=-2.112, P=.026<.05), and

v. Time spent for answering Geography audio (β=-3.388, P=.029<.05) were found significant.

Fortunately, the final model (video category) was significant, with R=.639, R^2=.409, F (5, 44) =6.086, P=.000<.001. The predictors such as:

i. Number of steps to reach Organization of Body video (β=1.569, P=.000<.001),

ii. Shell Programming video (β=-1.350, P=.000<.001),

iii. Amines video (β=-.423, P=.026<.05),

iv. Atoms and Heart video (β=1.320, P=.000<.001), and

v. General Psychology video (β=-.691, P=.004<.01) were significant predictors.

Based on the above results, the hypothesis 2 can be accepted except in the category of listening audio, which was not supported. These results accounted for 50.6%, 40.9%, and 21.4% of variance for reading text, watching video and listening audio respectively. See Figure (5.1.2) below.

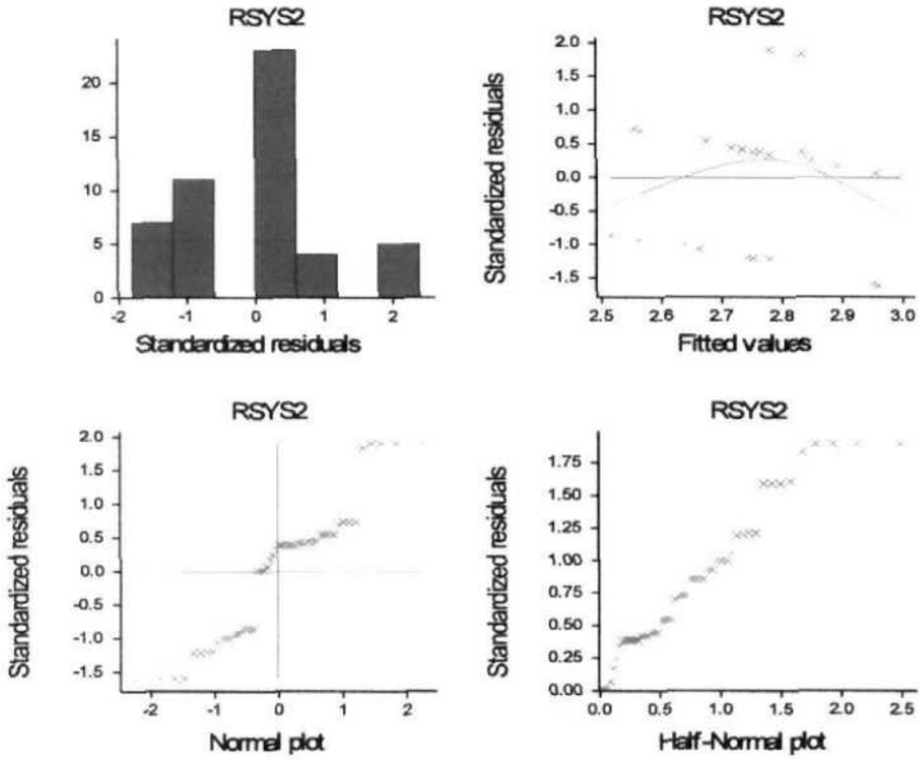
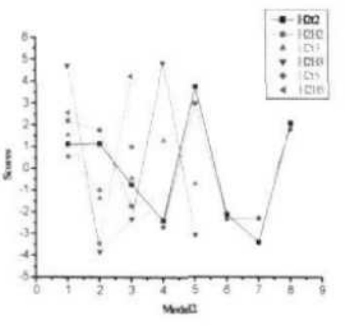


Figure (5.1.2, a) Influences of Efficiency of the Digital Library on students' Satisfaction



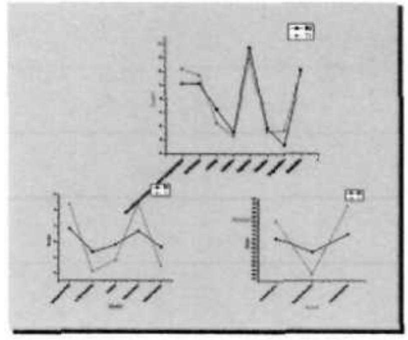


Figure (5.1.2, b) Influences of Efficiency of the Digital Library on students' Satisfaction

Influences of Efficiency on satisfaction (H2)

In this research, "***efficiency***" of using the digital library was studied in terms of reading papers, watching video and listening to audio. The findings in the first and second aspects supported the hypothesis 2 and accounted for 50.6% and 40.9% of variance respectively. These findings supported the findings of Nielsen (1993)[46], Blandford & Buchanan (2002)[7], Judy Jeng (2005a, 2005b)[30, 31].

However, considering the third aspect (audio), the hypothesis 2 was not supported, since it accounted for only 21.4% of variance. The RQ2 was affirmed for the first and second aspects of this hypothesis 2 but failed in the third aspect because of the reason that students may be more interested in reading papers, documents, e-books, or watching videos for different subjects but they have not much interest in listening to audio.

The above findings support the findings of Todoran Horea (2002)[27], Christel et al. (1997)[44], Plass and Homer (2002)[49], Kosiedowski et al. (2007)[45], and Dillon and Gabbard (1998)[20] empirical results.

5) RELATIONSHIP BETWEEN EFFECTIVENESS AND SATISFACTION

Research Question No. 3: Does the effectiveness of using the digital library materials have influences on students' satisfaction?

Hypothesis No. 3: "*The levels of effectiveness will have a significant impact on learner's satisfaction.*"

Table (5.1.7) Relationship between Effectiveness and Satisfaction: Unstandardized and standardized coefficients

Model		Unstandardized Coefficients	Standardized Coefficients		
		B	Beta	t	Sig.
4	(Constant)	4.149		7.403	.000(*)
	Dose the library have a paper copy of a-) Education History?	.477	.244	1.848	.071
	c-) What use in economic theory?	-1.202	-.574	-4.094	.000(*)
	d-) History of social Theory?	.547	.276	1.857	.040(***)
	e-) Teaching English to the World?	-.594	-.292	-2.073	.044(***)
a. Dependent Variable: Pleas, rank the ease of the System1					

*=P<.001 and ***=P<.05 indicate significance level.

When the relationships between "*effectiveness*" predictors and the dependent variable "*satisfaction1*" were analysed, the predictor "does the library have a paper copy of education history" (t=1.848, P=.071) was not found significant (Effectiveness in this study was measured by the instance of correct answer).

Inversely, the predictors:

i. What use in the economic theory (t=-.4.094, P=.000),

ii. History of social theory (t=1.857, P=.040), and

iii. Teaching English to the world (t=-2.073, P=.044), were significant.

Therefore, the hypothesis3 was accepted.

The values of R=.563, R^2=.317, F (4, 45) =5.213, P=.002<.01 were significant and the hypothesis 3 was partially supported (with paper categories) accounting 31.7% of the variance in effectiveness of the digital library materials use. The predictors namely,

i. What use in economic theory paper (β=-.574, P=.000<.001), and

ii. Teaching English to the world (β=-.292, P=.044<.05) were the only significant predictors.

Since the correlated predictors were found positive, the program was not rerun with these predictors. Hence the research question 3 was answered in affirmation.

The figure (5.1.3) below illustrates the Influence of effectiveness on students' Satisfaction.

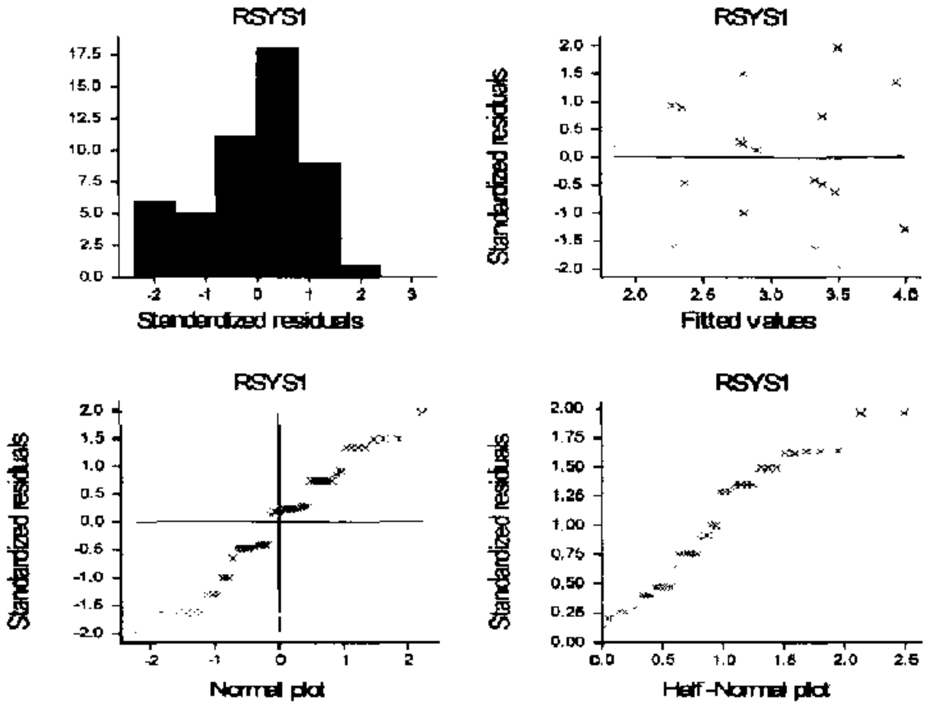


Figure (5.1.3, a) Influence of effectiveness on students' Satisfaction

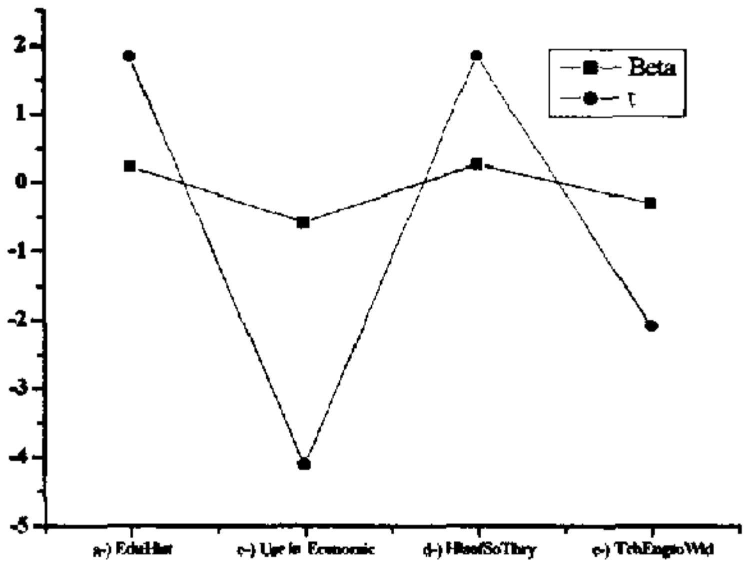


Figure (5.1.3, b) Influence of effectiveness on students' Satisfaction

Influence of Effectiveness on Satisfaction (H3)

The influence of predictor variables in this research as indicated by "PapEdu", "PapDff," "PapHis", and "PapTE" – were also supported by other researchers (Judy Jeng 2005a[30], 2005b[31]; Collins, Mane, Martinez, Hussell, Luce, 2005[16]; McCown, Bollen, Nelson, 2005[40]).

The findings show partial influences of "***effectiveness***" on students' "***satisfaction***" accounting for 31.7% of variance. This means that the RQ3 was partially fulfilled. However, when students were further inquired about PapEdu, PapDff, PapUseco, PapHis, and PapTE?, 50% of them said yes for PapEdu (with M=1.50, SD=0.505), 20% of the students said yes for PapDff (with M=1.20, SD=0.404), and 32% of the students said yes for PapUseco (with M=1.32, SD=0.471). On other side, 42% of the students said yes for PapHis (with M=1.42, SD=0.499), and 64% of students said yes for PapTE (with M=1.64, SD=0.485). This finding is similar to the findings of Judy Jeng (2005a, 2005b) [30, 31] empirical study on "***effectiveness***" and "***satisfaction***".

The reasons behind the above finding may be that the students had experienced Web Sites such as Google, Yahoo, etc. in their University. They used to visit Internet café and search for some information through reading text, documents and e-books to complete their learning tasks.

6) RELATIONSHIP BETWEEN LEARNING ACTIVITIES, USABILITY AND SATISFACTION (POST-TEST)

Research Question No. 4: What are the influences of learning activities and usability on the ease of use of the digital library?

Hypothesis No. 4: "*The levels of learning activities and usability will have a significant impact on ease of use of the digital library*".

Table (5.1.8) Relationship between Usability and Satisfaction (Post-Test): Unstandardized and standardized coefficients

Model		Unstandardized Coefficients	Standardized Coefficients		
		B	Beta	t	Sig.
6	(Constant)	2.026		2.137	.039(***)
	Does the library have links to the Journals?	-.627	-.383	-2.036	.049(***)
	Can you download a video about Skeletal System?	.474	.261	2.521	.016(***)
	Can you copy a paper addressed by Elizabeth Alice Honing Curriculum?	-.815	-.491	-4.104	.000(*)
	b-) Picture	.831	.774	7.975	.000(*)
	c-) Color	-.248	-.249	-2.580	.014(***)
	d-) Text	.730	.754	6.391	.000(*)
	Is the site visually attractive?	-.529	-.573	-3.646	.001(**)
	Can you recover from the mistakes easily?	.339	.426	4.357	.000(*)
	Your overall reaction to the system	-.690	-.772	-4.401	.000(*)
	Do you feel lost when using the site?	.843	.507	4.815	.000(*)

a. Dependent Variable: Please, rate the ease of the Use of the Web-Site

*=P<.001, **=P<.01, and ***=P<.05 indicate significance level.

Analyzing the relationships between "***learning activties***" and "***usability***" predictors (independent variables) and the "***ease of use***", (the dependent variable) as mentioned in table (5.1.8) the results supported the hypothesis 4. The relationships between predictors:

i. Does the library have links to the Journals? (browsing, t=-2.036, P=.049),

ii. Can you download a video about skeletal system? (information gathering, t=2.521, P=.016),

iii. Can you copy a paper addressed by Elizabeth Alice Honing? (t=-4.104, P=.000),

iv. Picture ranking (watching, t=7.975, P=.000),

v. Color ranking (t=-2.580, P=.014),

vi. Text ranking (reading, t=6.391, P=.000),

vii. Is the site visually attractive? (usability, t=-3.646, P=.001),

viii. Can you recover from the mistakes easily? (t=4.357, P=.000),

ix. Your overall reaction to the system? (t=-4.401, P=.000), and

x. Do you feel lost when using the site? (t=4.815, P=.000), and the dependent variable "***ease of use of the Web-site***" were all found significant.

The predictors under "***learning activities***" were tested via information gathering (copy papers, download audios and videos), information seeking (searching and browsing), and active consuming (reading text, listening audio, and watching video).

The model was significant with values of R=.892, R^2=.795, F (10, 39) =15.126, P=.000<.001. The Predictors such as:

i. Does the library have links to the Journals? (β=-.383, P=.049<.05),

ii. Can you download a video about Skeletal System? (β=.261, P=.016<.05),

iii. Can you copy a paper addressed Elizabeth Alice Honing Curriculum? (β=-.491, P=.000<.001),

iv. Picture (β=.774, P=.000<.001),

v. Color (β=-.249, P=.014<.05),

vi. Text (β=.754, P=.000<.001),

vii. Is the site visually attractive? (β=-.573, P=.001<.01),

viii. Can you recover from the mistake easily? (β=.426, P=.000<.001),

ix. Your overall reaction to the system (β=-.772, P=.000<.001), and

x. Do you feel lost while using the site? (β=.507, P=.000<.001) were significant predictors for "***learning activities***" and "***usability***".

Thus, the hypothesis 4 was fully supported via "***learning activities***" and "***usability***" accounting for 79.5% of the variance.

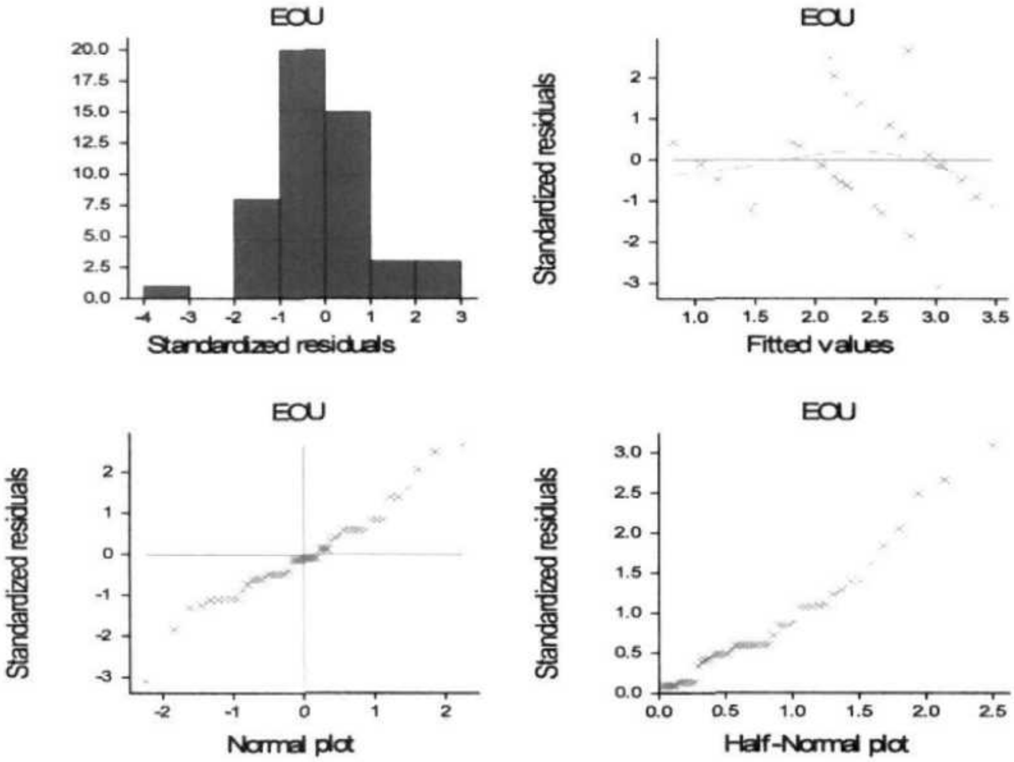


Figure (5.1.4, a) Influences of Learning Activities and Usability on Students' Satisfaction

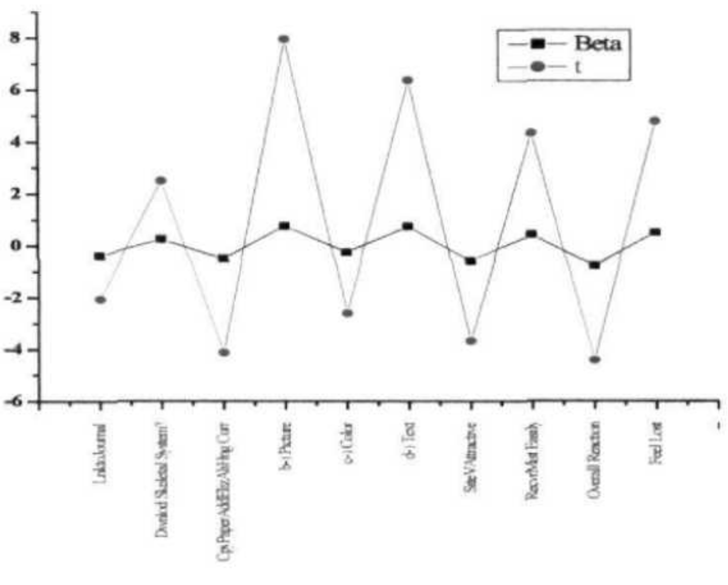


Figure (5.1.4, b) Influences of Learning Activities and Usability on Students' Satisfaction

Influences of Learning Activities and Usability on Ease of Use (H4)

Several studies have been conducted on information seeking (Jayawardana, 2001[29]; McNally, Kuhlthau, 1994[41]; Fine, 1984[23]; Kuhlthau, 1993[36]; Marchionini, 1989a[38]). Jayawardana (2001)[29] discussed that personalized information environment (PIE) in a digital library was a framework that provided a set of integrated tools based on individual user's requirements and interests with respect to his access to library materials. These tools can support active learning by integrating the user's personal library and a remote digital library. McNally and Kuhlthau (1994)[41] described how information seeking consists of both undirected and highly directed activities – undirected searching that leads to unexpected links, or discrepant events related to their topics, and highly directed searching for finding specific information.

Fine, (1984)[23] suggested that individuals engage in information seeking for a number of reasons: to reduce ambiguity; increase their ability to cope with situations, to make decisions, to locate information that will lesson their anxiety, or more toward a desired goal. In a sense, the search event involves problem solving, not simply information finding. It is comparing student activity to the research behaviors of scientists. Kuhlthau (1993)[36] suggested a conceptualization beyond merely seeking and gathering information to a more rigorous constructive process of using information to solve the problem which initiated the information need. Marchionini (1989a)[38] defined information seeking as a special case of problem solving where learners recognize and interpret an information problem, establish a plan of search, conduct the search, evaluate the results, and if necessary, iterate through the process again.

Several other theoretical perspectives of learning and teaching, learning and multimedia, learning materials, and learning outcomes (Wu, Witten, 2006[61]; Marchionini, Paisant, Komlodi, 2003[39]; Fuentes, C. A., 2003[24]; Tane et al., 2003[56]; Borgman et al., 2000[9]), framework of usability (Kassim, Kochtanek, 2003[33]; Kengeri et al., 1997[50]; Shneiderman, 1998[52], Nielsen, 1993[46]; Blandford & Buchanan, 2003[8]; Judy Jeny 2005a[30], 2005b[31]), and information gathering (Brockman, Neumann, Palmer, Tidline, 2001[10]) are also reviewed. They noted, "As scholars were finishing one document, they made notes of idea they had to expand for another publication. They ran searches to fill in gaps in their bibliography or quickly checked something, communicated with friends in other places who were helping them gather information, or kept up with departmental discussions about administrative issues" (Brockman, Neumann, Palmer, Tidline, 2001[10], pp.27).

The findings at this level proved that there are influences of the levels of "***learning activities***" and "***usability***" on the ease of use of the digital library. This finding supports the hypothesis 4 and answers the RQ4 by accounting for 79.5% of variance. The subjects were asked about various learning activities and it was noticed that 66% of the students said yes for Jor (with M=1.66, SD=0.479), 64% of them said yes for Mgzn (with M=1.65, SD=0.485), 76% said yes for DwnV (with M=1.76, SD=0.431), 74% said yes for DwnA (with M=1.74, SD=0.443), 68% said yes for CpyP (with M=1.68, SD=0.471). However, 64% said the sound was medium whereas 26% said it was clear (with M=2.84, SD=0.584), 20% said the picture was very clear, and 46% said it was clear (with M=2.14, SD=0.729), 10% said the color was very clear, 44% said it was clear whereas 38% said it was medium (with M=2.44, SD=0.787), and 10% said the text was very clear, 30% said it was clear, and 50% said it was medium (with M=2.60, SD=0.808).

On the other hand, 10% said OrgInfo was very clear, 40% said it was clear, and 40% said it was medium (with M=2.50, SD=0.814), 12% of them rated Attrc to be very high, 54% said it was attractive, and 22% said it was medium (with M=2.34, SD=0.848), 20% of the students responded about Ractn to be fully satisfied, 18% said it was satisfying, and 54% reported about medium level satisfaction (M=2.74, SD=0.876). Furthermore, 32% of the students said yes for being Lost (with M=1.32, SD=0.471), whereas, 62% of the students said yes for the Nvgt (with M=1.62, SD=0.490).

These findings were similar to the findings of Jayawardana (2001)[29], Marchionini, Paisant, and Komlodi (1998)[39], and Judy Jeng (2005a, 2005b) [30, 31] empirical results and also supported content-based image retrieval concepts in categories of color (Rui et al., 1999[51]; Del Bimbo, 1999[19]), texture (Haralick, 1979[26]; Tamura, Mori, and Yamawaki, 1978[55]; Picard and Minka[48]; Manjunath and Ma, 1996[37]), shape (Mehrotra and Gary, 1995[42]), and text and image (Chen, 2006[14]). For more details see Chapter 3.

7) RELATIONSHIP BERWEEN EXPERIENCE AND INTERNET USE

Research Question No. 5: What are the impacts of students' experience on using Internet?

Hypothesis No. 5: "*The levels of learner's experience will have a significant impact on using the Internet.*"

Table (5.1.9) Relationship between Experience and Internet: Unstandardized and standardized coefficients

Model		Unstandardized Coefficients	Standardized Coefficients		
		B	Beta	t	Sig.
7	(Constant)	-2.111		-7.523	.000(*)
	Do you Search most of your information requirements from Web site?	.800	.195	4.557	.000(*)
	Are you attracted to Internet of a-)Specific Journals?	-.778	-.182	-4.854	.000(*)
	d-) wide searching and browsing?	2.222	.675	9.078	.000(*)
	Do you use the help facilities when using Web-Site?	.867	.259	3.354	.002(**)
a. Dependent Variable: How many times do yo use Internet in a week?					

*=P<.001 and **=P<.01 indicate significance level.

The students' "*experience*" was entered as the predictor against the dependent variable "***instances of using the Internet per week***". Here, some predictors supported the hypothesis 5. The relationships of the predictors:

i. Do you search most of your information requirements from the web site? (t=4.557, P=.000),

ii. Are you attracted by the specific Journals of the Internet? (t=-4.854, P=.000),

iii. Are you attracted to the Internet for wide searching and browsing? (t=9.078, P=.000), and

iv. Do you use the help facilities while using the web site? (t=3.354, P=.002), with the dependent variable "***How many times do you use Internet in a week?***" were found to be significant.

By applying multiple regression technique on the variable Internet information, (which consisted of fourteen items), significant results were obtained with R=.974, R^2=.948, F (4, 45) =207.119, P=.000<.001. The predictors such as:

i. Do you search most of your information requirements from web site? (β=.195, P=.000<.001),

ii. Are you attached to the Internet of specific Journals? (β=-.182, P=.000<.001),

iii. Are you attached to Internet of wide searching and browsing? (β=.675, P=.000<.001), and

iv. Do you use the help facilities when using web site? (β=.259, P=.002<.01) were significant predictors.

The correlation matrix for these predictors showed a positive correlation between these predictors. Thus, the hypothesis 5 was fully supported with "***Internet experience***" accounting for 94.8% of the variance in the digital library and "***Internet***" use.

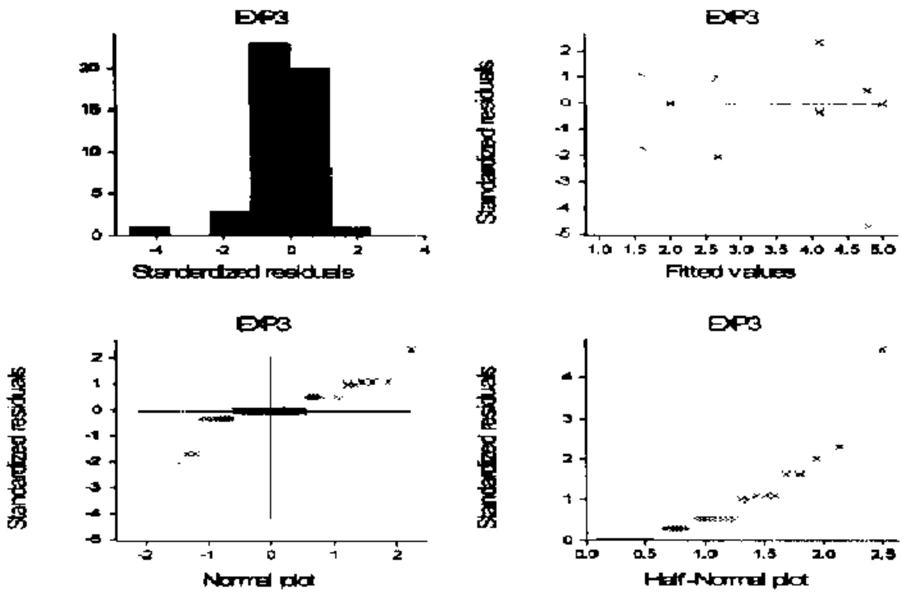


Figure (5.1.5, a) Influences of Students' Experience and using Internet

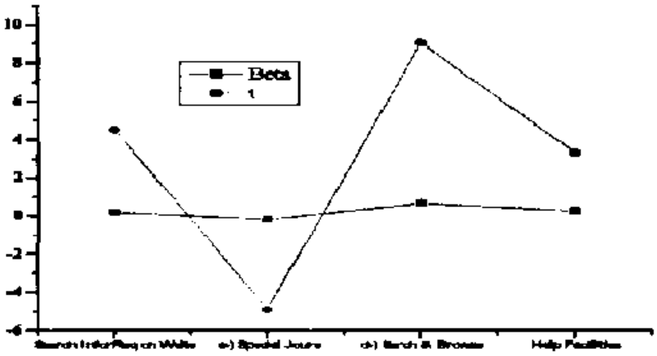


Figure (5.1.5, b) Influences of Students' Experience and using Internet

Influences of Experience of Students on Internet (H5)

The study also found that 18% of the students were attracted to the Internet for specific Journals (with M=1.18, SD=0.388), 24% preferred a particular day for browsing the Internet web sites (with M=1.24, SD=0.431), and 24% of them were attracted to the Internet for using specific digital libraries (with M=1.24, SD=0.431).

On the other hand, 30% of the students were attracted to the Internet for using specific Magazines (with M=1.30, SD=0.463), 34% of the students preferred the web site because of certainty of getting material (with M=1.34, SD=0.479), 54% of them preferred the web site because of wide searching and browsing (with M=1.54, SD=0.503), and 60% of the students used the help facilities while using web site (with M=1.60, SD=0.495). Furthermore, 62% of the students preferred the web site for availability of their information needs under one site (with M=1.62, SD=0.490), and 80% of them searched most of their information requirements from web site (with M=1.80, SD=0.404), however, 70% of the students preferred the web site for availability of information in short time (with M=1.70, SD=0.463), and 82% of the students were attracted to the Internet for specific web site (with M=1.82, SD=0.388). Moreover, 24% of the students used the Internet once a week, 18% used the Internet twice a week, 6% of them used the Internet three times per week, and 16% 0f the students used the Internet four times and above per week (with M=3.22, and SD=0.1.657). These results answered the research question 5 in affirmation. Thus, it can be concluded that, the students heavily rely on the Internet for their academic activities.

The finding of this study confirmed the hypothesis 5 by accounting for 94.8% of variance, and supported Windschitl's (1998[57], 2000[58]) & Arpit Jan's (2008)[3] empirical results. Windschitl particularly emphasized the importance of asking critical questions about add value of the use of the web in education and web-based learning empirical results.

8) RELATIONSHIP BETWEEN LEARNABILITY AND EASE OF LEARN

Research Question No. 6: What are the influences of the digital library learnability on the ease of learn?

Hypothesis No. 6: "*The levels of digital library learnability will have a significant impact on ease of learn of the digital library.*"

Table (5.1.10) Relationship between Learnability and ease of learn: Unstandardized and standardized coefficients

Model		Unstandardized Coefficients	Standardized Coefficients		
		B	Beta	t	Sig.
8	(Constant)	5.427		11.864	.000(*)
	c-)Audio History	-1.040	-.419	-2.642	.011(***)
	f-)Download iTunes	-.657	-.282	-2.229	.031(***)
	b-)Video Org of Body	.952	.374	1.813	.076
	4-)Learning Effort	-.473	-.581	-3.030	.004(**)
a. Dependent Variable: 3-)Ease of Learn					

*=P<.001, **=P<.01, and ***=P<.05 indicate significance level.

The relationship of "***learnability***" as the predictor was studied with the "***ease of learn***" as the dependent variable by using multiple regression technique, and the results supported the hypothesis 6.

There was only one predictor (organization of body video), which did not support hypothesis 6. Moreover, the predictors such as:

i. History audio ($t=-2.642$, $P=.011$),

ii. Download iTunes software ($t=-2.229$, $P=.031$), and

iii. Learning effort ($t=-3.030$, $P=.004$) were found significant.

To analyze the influence of "***learnability***" on "***ease of learn***", fourteen items were tested with the help of multiple regression technique (See Appendix E). The model was significant with values, $R=.823$, $F^2=.678$, $F(4, 45)=23.700$, $P=.000<.001$. The Predictors such as:

i. Audio history ($\beta=-.419$, $P=.011<.05$),

ii. Download iTunes software ($\beta=-.282$, $P=.031<.05$), and

iii. Learning effort ($\beta=-.581$, $P=.004<.01$) were the only significant predictors.

Thus, the hypothesis 6 was fully supported by accounting for 67.8% of the variance.

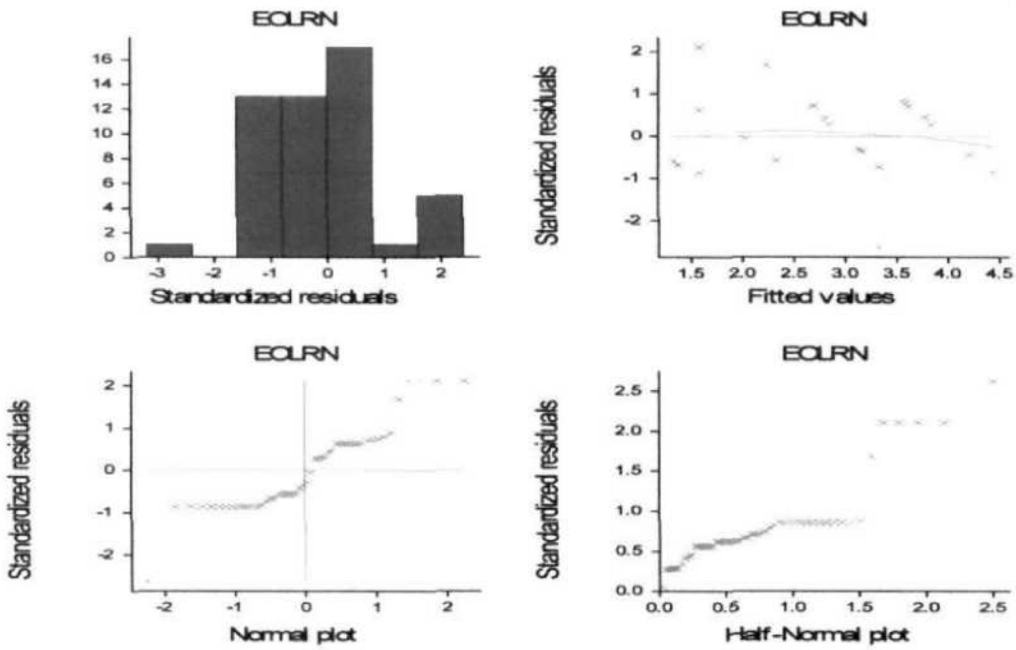


Figure (5.1.6, a) Influence of Learnability on Ease of Learn

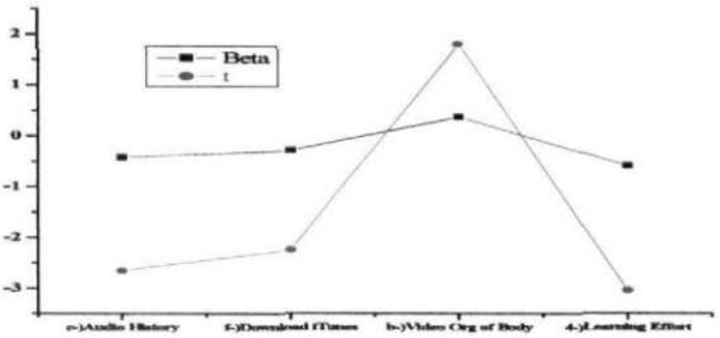


Figure (5.1.6, b) Influence of Learnability on Ease of Learn

Influence of Learnability on Ease of Learn (H6)

Learnability is the most fundamental usability attributes (Nielsen, 1993)[46]. The system should be easy to learn so that the students or users can rapidly start getting some work with the system.

The finding of this study at this stage answers the Q.6. In this study the researcher used the map of steps as mentioned in the chapter 4 to ensure the ease of learn of BDL in the same situation from different aspects. This method is different from the methods used by

Nielsen[46] and Judy Jeng [30, 31] but the finding of this study supports Nielsen's (1993)[46] and Judy Jeng's (2005a, 2005b) [30, 31] empirical results.

9) RELATIONSHIP BETWEEN TIME SPENT & EASE OF THE SYSTEM (RSYS1)

Research Question No. 7: What are the influences of the time spent in using the digital library on students' satisfaction?

Hypothesis No. 7: "*The levels of time spent using the digital library will have a significant impact on learner's satisfaction.*"

Table (5.1.11) Relationship between Time Spent & Ease of the System (RSys1): Unstandardized and standardized coefficients

Model		Unstandardized Coefficients	Standardized Coefficients		
		B	Beta	t	Sig.
10	(Constant)	2.328		9.237	.000(*)
	tm1c	.235	.570	2.594	.013(***)
	tm1d	-.453	-.974	-3.433	.001(**)
	t1e	.378	1.016	4.261	.000(*)

a. Dependent Variable: **Please, rank the ease of the System1** (RSys1)

Table (5.1.11) explained the relationship between the independent variables "***time spent***" to reach the answer of questions (paper category) and the dependent variable students' "***satisfaction1***".

The predictors such as:

i. Time spent to reach the answer of the question "does the library have a paper of what use in economic theory?" (tm1c, t=2.594, P=.013),

ii. Time spent to answer the question of "history of social theory" (tm1d, t=-3.433, P=.001), and

iii. Time spent to answer the question of teaching English to the world (tm1e, t=4.261, P=.000), were found significant.

Hence the results supported the hypothesis 7 (paper category).

10) RELATIONSHIP BETWEEN TIME SPENT & EASE OF THE SYSTEM2 (RSYS2)

Table (5.1.12) Relationship between Time Spent & Ease of the System (RSys2): Unstandardized and standardized coefficients

Model		Unstandardized Coefficients	Standardized Coefficients		
		B	Beta	t	Sig.
11	(Constant)	2.913		14.156	.000(*)
	tm2a	.073	.477	.594	.556
	tm2b	.043	.266	.592	.557
	tm2c	-.089	-.529	-.713	.480
	tm2d	.002	.012	.015	.988
	tm2e	-.055	-.349	-.502	.618

a. Dependent Variable: Please, rank the ease of the System2 (RSys2)

*=P<.001, **=P<.01, and ***=P<.05 indicate significance level.

Table (5.1.12) explained the relationship between the independent variables "***time spent***" to reach the answers (audio category) and the dependent variable students' "***satisfaction2***".

The predictors such as time spent a, b, c, d, and e were not significant predictors because of the obtained values t=0.594, P=.556, t=0.592, P=.557, t=-0.713, P=.480, t=0.015, P=.988, and t=- 0.502, P=.618 respectively which were greater than 0.05.

11) TIME SPENT & EASE OF THE SYSTEM3 (RSYS3)

Table (5.1.13) Relationship between Time Spent & Ease of the System (RSys3): Unstandardized and standardized coefficients

Model		Unstandardized Coefficients	Standardized Coefficients		
		B	Beta	t	Sig.
14	(Constant)	2.911		14.388	.000(*)
	tm3c	-.322	-2.020	-2.950	.005(**)
	tm3d	.324	1.975	2.885	.006(**)
a. Dependent Variable: Please, rank the ease of the System3 (RSys3)					

Table (5.1.13) indicated the relationship between the predictors of "*time spent*" and dependent variable students' "*satisfaction3*" (video category).

The results were significant because the predictors had the following values: t=-2.950, P=.005 for tm3c and t=2.885, P=.006 for tm3d, which were less than .01.

Hence, the hypothesis 7 (video category) was confirmed.

The researcher tested the prediction of the "*time spent*" for getting answers for the three categories, via, finding papers, audios and videos through a regression.

The first result was found significant with R=.711, R^2=.506, F (3, 46) =15.718, P=.000<.001. The predictors namely:

i. tm1c (β=.570, P=.013<.05),

ii. tm1d (β=-.974, P=.001<.01), and

iii. t1e (β=1.016, P=.000<.001) were the only significant predictors.

The second result was not significant with R=.219, R^2=.048, F (5, 44) =.443, P=.816>.05.

The third result was again significant with R=.395, R^2=.156, F (2, 47) =4.353, P=.018<.05. The predictors:

i. tm3c (β=-2.020, P=.005<.01) and

ii. tm3d (β=1.975, P=.006<.01) were the only significant predictors.

Thus, the hypothesis 7 was accepted by accounting for 50.6% variance and 15.6% variance in the paper and video category respectively.

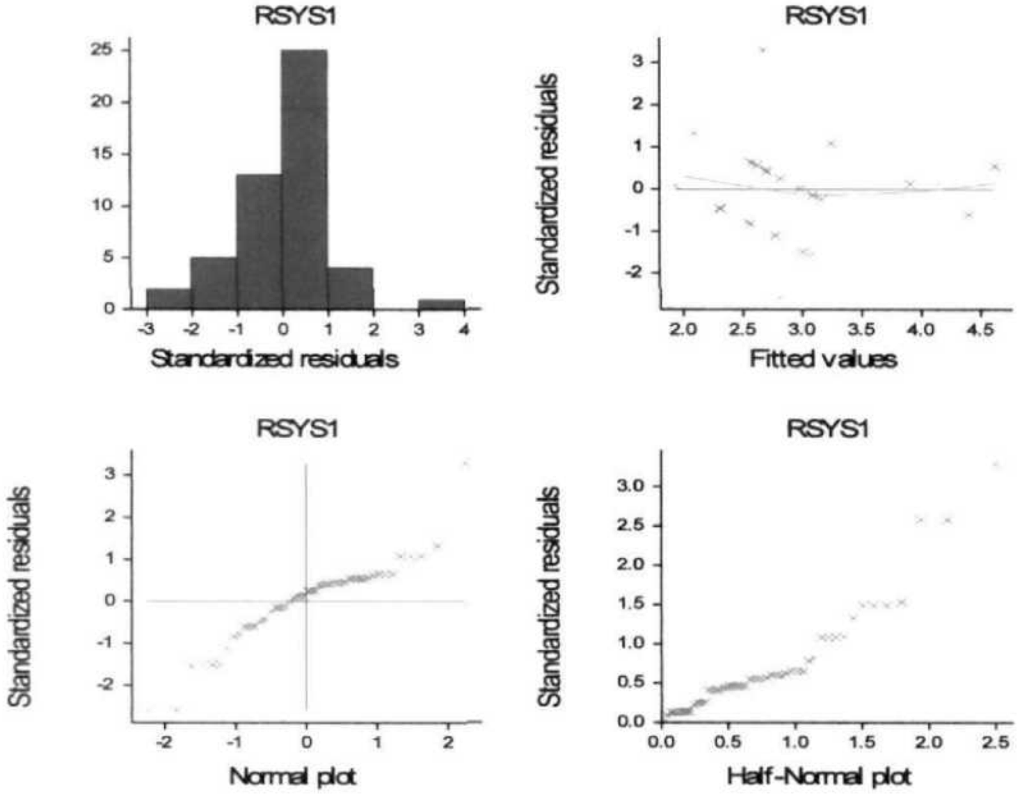


Figure (5.1.7, a) Influence of Time on Students' Satisfaction

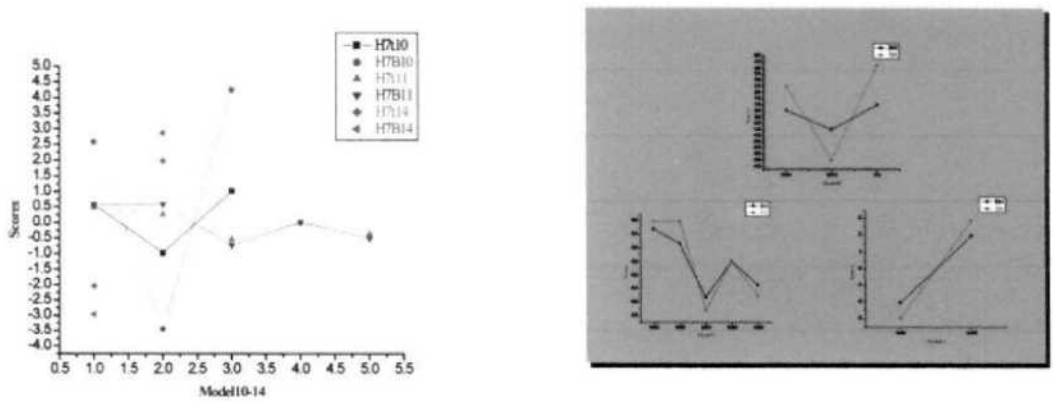


Figure (5.1.7, b) Influence of Time Spent on Students' Satisfaction

Influences of Time Spent on Students' Satisfaction (H7)

Judy Jeng (2005a, 2005b) [30, 31] discussed the correlation between "***time spent***" and "***satisfaction***" which was significant. In this study, three models were used in three categories, viz, text (papers), audio, and video. The results in first and third model were significant and answered the RQ7 by accounting for 50.6% and 15.6% of the variance respectively. Therefore, it can be concluded that there are influences of "***time spent***" for using the digital library on students' "***satisfaction***"; that means less time spent higher will be the satisfaction.

These findings hold true when the learner searches the text or e-content but in the category of search for videos, it will be different. The downloading of a video for education purpose takes more time rather than copying text but the results of watching it give positive influence and increase satisfaction. On the other side of the picture, the downloading of audio also takes some more time but less than downloading of a video. However, listening to an audio decreases students' satisfaction which means high time spent, less satisfaction because there is less interaction between students and the sound of the teachers or educators, thus resulting into lesser influences upon the learner.

12) RELATIONSHIP BETWEEN NUMBER OF STEPS & EASE OF THE SYSTEM1 (RSYS1: SATISFACTION1)

Research Question No. 8: Can the number of steps of using the digital library materials lead to the full students' satisfaction?

Hypothesis No. 8: *The levels of steps to reach the digital library materials will have a significant impact on learner's satisfaction*

Table (5.1.14) Relationship between Number of Steps & Ease of the System1 (RSys1: Satisfaction1): Unstandardized and standardized coefficients

Model		Unstandardized Coefficients	Standardized Coefficients		
		B	Beta	t	Sig.
9	(Constant)	5.830		2.978	.005(**)
	mosa	.165	.146	.674	.504
	mosb	-.451	-.433	-1.649	.106
	mosc	-.111	-.084	-.504	.617
	mosd	-.384	-.207	-1.300	.200
	mose	-.121	-.131	-.610	.545

a. Dependent Variable: **Please, rank the ease of the System1** (RSys1)

The relationship between the independent variables "***number of steps***" (paper category) and the dependent variable students' "***satisfaction1***" was obtained, through multiple regression.

The predictors number of steps a, b, c, d, and e were not significant predictors as they had values t=0.674, P=.504, t=-1.649, P=.106, t=-0.504, P=.617, t=-1.300, P=.200, and t=-0.610, P=.545 respectively which were greater than 0.05.

These results did not support the hypothesis 8.

13) RELATIONSHIP BETWEEN NUMBER OF STEPS & EASE OF THE SYSTEM2 (RSYS2: SATISFACTION2)

Table (5.1.15) Relationship between Number of Steps & Ease of the System2 (RSys2: Satisfaction2): Unstandardized and standardized coefficients

Model		Unstandardized Coefficients	Standardized Coefficients		
		B	Beta	t	Sig.
12	(Constant)	2.604		3.507	.001(**)
	English	.053	.064	.173	.864
	Philosophy	.204	.265	.465	.645
	History	-.177	-.281	-.695	.491
	Geography	.207	.222	.926	.360
	Statistics	-.271	-.397	-.860	.394
a. Dependent Variable: **Please, rank the ease of the System2** (RSys2)					

*=P<.001, **=P<.01, and ***=P<.05 indicate significance level.

Table (5.1.15) explained the relationship between the independent variables "***number of steps***" (audio category) and the dependent variable students' "***satisfaction2***".

The predictors such as number of steps required to reach English, philosophy, history, geography, and statistics materials were not significant predictors because of the obtained values t=0.173, P=.864, t=0.465, P=.645, t=-0.695, P=.491, t=0.926, P=.360, and t=-0.926, P=.360 respectively which were greater than 0.05.

These results did not support the hypothesis 8 that, "*The levels of steps to reach the digital library materials will have a significant impact on learner's satisfaction*".

14) NUMBER OF STEPS & EASE OF THE SYSTEM3 (RSYS3: SATISFACTION3)

Table (5.1.16) Relationship between Number of Steps & Ease of the System3 (RSys3: Satisfaction3): Unstandardized and standardized coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
13	(Constant)	.971	1.083		.897	.375
	VOrBod	1.466	.311	1.569	4.719	.000(*)
	VSPro	-1.831	.480	-1.350	-3.812	.000(*)
	VAms	-.356	.155	-.423	-2.296	.026(***)
	VAHrt	1.711	.352	1.320	4.857	.000(*)
	VGPscho	-.661	.218	-.691	-3.035	.004(**)
a. Dependent Variable: **Please, rank the ease of the System3** (RSys3)						

Table (5.1.16) explained the relationship between the independent variables "***number of steps***" (video category) and the dependent variable students' "***satisfaction3***".

The predictors "***number of steps***" required to reach a video on organization of body (VOrBOd), shell programming video (VSPro), amines video (VAms), atoms and heart video (VAHrt), and general psychology video (VGPscho) were significant predictors as they had values t=4.719, P=.000, t=-3.812, P=.000, t=-2.296, P=.026, t=4.857, P=.000, and t=-3.035, P=.004 respectively which were less than or equal to 0.001, 0.01, or 0.05.

These results also helped confirming the hypothesis 8.

The researcher further tested the prediction for different categories (three models) of the digital library materials through a regression.

The first result was not significant with R=.291, R^2=.085, F (5, 44) =.815, P=.546. The second result was also not significant with R=.230, R^2=.048, F (5, 44) =.494, P=.779.

However, the third result was significant with R=.639, R^2=.409, F (5, 44) =6.086, P=.000<.001. The predictors namely:

i. Organization of Body video (β=1.569, P=.000<.001),

ii. Shell programming video (β=-1.350, P=.000<.001),

iii. Amines video (β=-.423, P=.026<.05),

iv. Atoms and Heat video (β=1.320, P=.000<.001), and

v. General Psychology video (β=-.691, P=.004<.01) were the only significant predictors.

Thus, the hypothesis 8 was not confirmed.

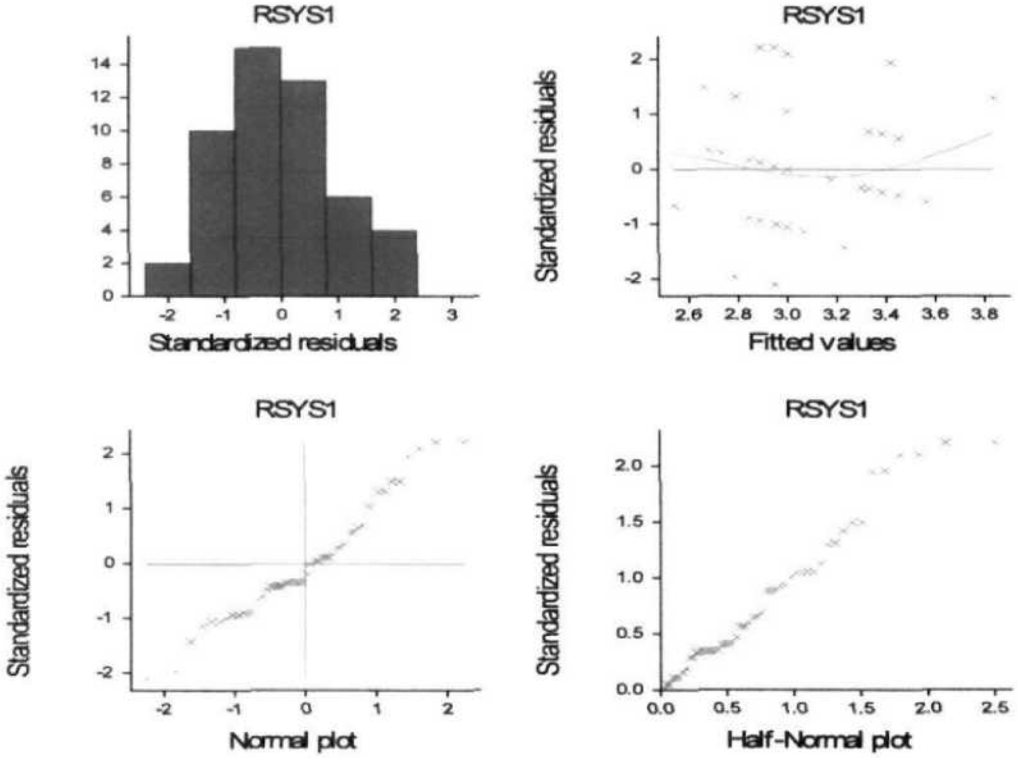


Figure (5.1.8, a) Influence of Number of Steps on students' Satisfaction

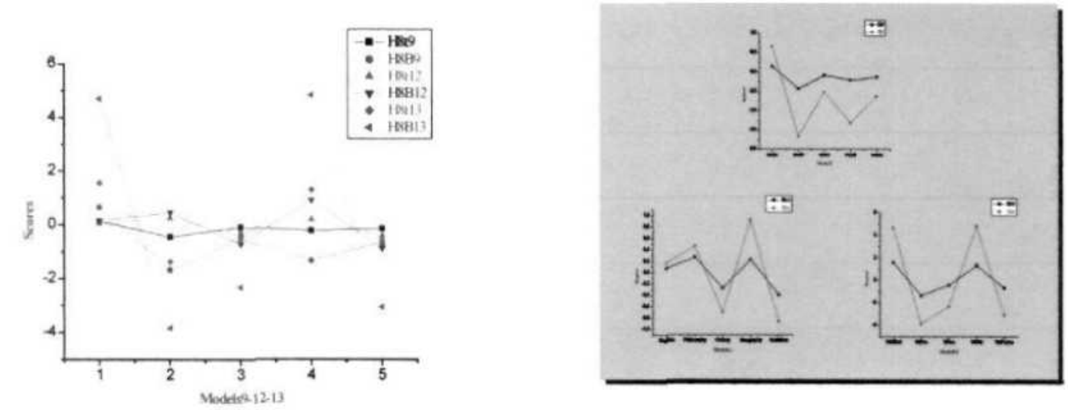


Figure (5.1.8, b) Influence of Number of Steps on students' Satisfaction

The above findings of this study were similar to the findings of Judy Jeng (2005a, 2005b) [30, 31] in the category of searching for multimedia (video). The reasons for obtaining the above results may be that when students interact with image motion and fulfill both reading and writing text, listening and watching teachers through the video, they feel more satisfied. All procedures that occur in the classroom can be followed through video after the class or online. They can also ask questions, answer questions and send notes to teachers or educators through the e-mail. On the contrary searching for papers is like a silent conversation between the information and students, therefore, it may be less satisfying.

15) RELATIONSHIP BETWEEN LEARNING ACTIVITIES & EASE OF THE SYSTEM3 (RSYS3: SATISFACTION3)

Research Question No. 9: What are the influences of learning activities on students' satisfaction?

Hypothesis No. 9: *The levels of learning activities will have a significant impact on the learner's satisfaction*

Table (5.1.17) Relationship between Learning Activities & Ease of the System3 (RSys3: Satisfaction3): Unstandardized and standardized coefficients

Model		Unstandardized Coefficients	Standardized Coefficients		
		B	Beta	t	Sig.
15	(Constant)	4.379		8.000	.000(*)
	DwnV	-.598	-.377	-2.531	.015(***)
	CpyP	-.466	-.321	-2.201	.033(***)
	Snd	.321	.273	2.292	.027(***)
	Pctr	-.222	-.236	-1.952	.057
a. Dependent Variable: Please, rank the ease of the System3 (RSys3)					

Table (5.1.17) explained the relationship between "*learning activities*" variables as the predictors and students' "*satisfaction3*" as dependent variable.

The predictors namely:

i. Download video (t=-2.531, P=.015),

ii. Copy paper (t=-2.201, P=.033), and

iii. Sound ranking (t=2.292, P=.027), with the dependent variable "*satisfaction*" for watching video were significant.

These results supported the hypothesis 9.

Inversely, the predictor picture ranking (t=-1.952, P=.057) was not significant.

16) RELATIONSHIP BETWEEN LEARNING ACTIVITIES & EASE OF THE SYSTEM2 (RSYS2: SATISFACTION2)

Table (5.1.18) Relationship between Learning Activities & Ease of the System2 (RSys2: Satisfaction2): Unstandardized and standardized coefficients

Model		Unstandardized Coefficients	Standardized Coefficients		
		B	Beta	t	Sig.
16	(Constant)	2.697		5.401	.000(*)
	Jor	-.736	-.557	-3.759	.001(**)
	Mgzn	-.511	-.392	-2.394	.021(***)
	DwnV	-.524	-.357	-2.770	.008(**)
	DwnA	.594	.416	2.778	.008(**)
	CpyP	.465	.346	2.451	.018(***)
	Snd	.426	.393	3.697	.001(**)

a. Dependent Variable: **Please, rank the ease of the System2** (RSys2)

Table (5.1.18) explained the relationship between "***learning activities***" variables as the predictors and students' "***satisfaction2***" as dependent variable.

The predictors:

i. Looking for Journals (t=-3.759, P=.001),

ii. Looking for Magazines (t=-2.394, P=.021),

iii. Download video (t=-2.770, P=.008),

iv. Download audio (t=2.778, P=.008),

v. Copy paper (t=2.451, P=.018), and

vi. Sound ranking (t=3.697, P=.001), were significant.

Therefore, these results supported the hypothesis 9.

17) RELATIONSHIP BETWEEN LEARNING ACTIVITIES & EASE OF THE SYSTEM1 (RSYS1: SATISFACTION1)

Table (5.1.19) Relationship between Learning Activities & Ease of the System1 (RSys1: Satisfaction1): Unstandardized and standardized coefficients

Model		Unstandardized Coefficients	Standardized Coefficients		
		B	Beta	t	Sig.
17	(Constant)	4.323		6.561	.000(*)
	Mgzn	-.996	-.490	-4.108	.000(*)
	Colr	-.368	-.293	-2.198	.033(***)
	Txt	.496	.406	3.072	.004(**)
a. Dependent Variable: Please, rank the ease of the System1 (RSys1)					

Table (5.1.19) explained the relationship between "***learning activities***" variables as the predictors and students' "***satisfaction1***" (reading text) as dependent variable.

The predictors namely:

i. Looking for Magazines (t=-4.108, P=.000),

ii. Color ranking (t=-2.198, P=.033), and

iii. Text ranking (t=3.072, P=.004), were significant.

These results supported the hypothesis 9.

Three models were tested using the multiple regression technique.

The first result was significant with R=.617, R^2=.381, F (3, 46) =9.439, P=.000<.001. The predictors:

i. Magazine (β=-.490, P=.000<.001),

ii. Color (β=-.239, P=.033<.05), and

iii. Text (β=.406, P=.004<.01) were the only significant predictors.

The second result was significant with $R=.755$, $R^2=.570$, $F(6, 43)=9.496$, $P=.000<.001$. The Predictors namely:

i. Journals ($\beta=-.557$, $P=.001<.01$),

ii. Magazines ($\beta=-.392$, $P=.021<.05$),

iii. Download audio ($\beta=.416$, $P=.008<.01$),

iv. Download video ($\beta=-.357$, $P=.008<.01$),

v. Copy paper ($\beta=.346$, $P=.018<.05$), and

vi. Sound listening skills ($\beta=.393$, $P=.001<.01$) were the only significant predictors.

The third result was also significant with $R=.647$, $R^2=.419$, $F(4, 45)=8.111$, $P=.000<.001$. The Predictors:

i. Download video ($\beta=-.377$, $P=.015<.05$),

ii. Copy paper ($\beta=-.321$, $P=.033<.05$), and

iii. Listening sound skills ($\beta=.273$, $P=.027<.05$) were the only significant predictors.

It can be noted that the hypothesis 9 was supported by accounting for 38.1%, 57%, and 41.9% of variance for the 3 models respectively.

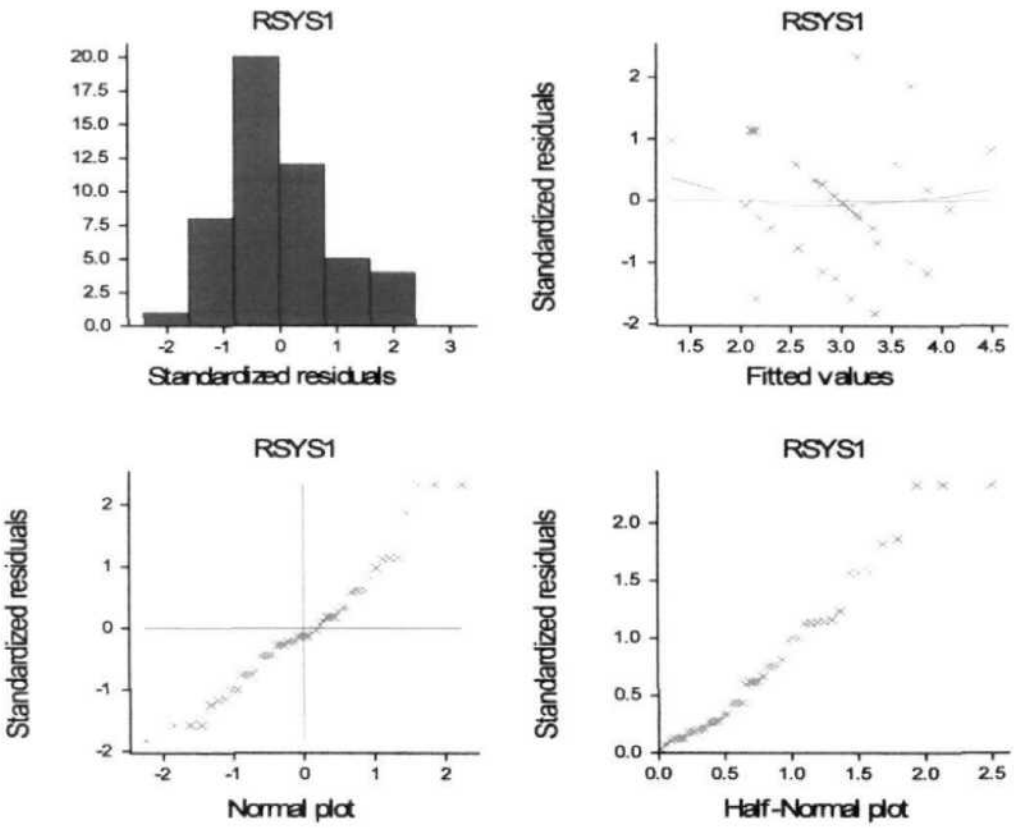


Figure (5.1.9, a) Influence of Learning Activities on students' Satisfaction

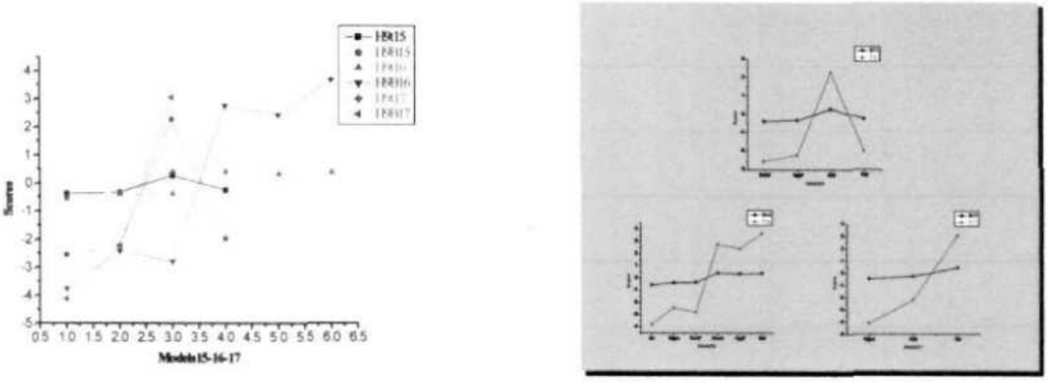


Figure (5.1.9, b) Influence of Learning Activities on students' Satisfaction

Influences of learning activities on students' satisfaction (H9)

This study answers RQ9 as mentioned above with the support of three models and were significant accounting for 38.1%, 57%, and 41.9% respectively. "***Learning activities***" are the major concern of this study. These activities such as searching, browsing, listening, watching, reading, copying, downloading etc. are increasing with paradigm shift in education in the current era. It is a fact that more activities lead to larger satisfaction and fewer activities lead to lesser satisfaction.

18) RELATIONSHIP BETWEEN LEARNING ACTIVITIES & EASE OF LEARN (LEARNABILITY)

Research Question No. 10: What are the influences of learning activities on learnability of the digital library?

Hypothesis No. 10: "*The levels of learning activities will have a significant impact on the digital library learnability.*"

Table (5.1.20) Relationship between Learning Activities & Ease of Learn (Learnability): Unstandardized and standardized coefficients

Model		Unstandardized Coefficients	Standardized Coefficients		
		B	Beta	t	Sig.
18	(Constant)	4.526		2.487	.017(***)
	Jor	-.140	-.061	-.263	.794
	Mgzn	.285	.126	.480	.634
	DwnV	.112	.044	.209	.835
	DwnA	-.854	-.345	-1.393	.171
	CpyP	-.259	-.111	-.499	.620
	Snd	-.015	-.008	-.040	.968
	Pctr	-.149	-.099	-.510	.613
	Colr	.058	.041	.189	.851
	Txt	-.222	-.163	-.806	.425
a. Dependent Variable: EOLrn					

Table (5.1.20) explained the relationship between "***learning activities***" variables as the predictors and "***ease of learn***" of the digital library as dependent variable.

The predictors namely:

i. Looking for Journals (t=-0.263, P=.794),

ii. Looking for Magazines (t=0.480, P=.634),

iii. Download video (t=0.209, P=.835),

iv. Download audio (t=-1.393, P=.171),

v. Copy paper (t=-0.499, P=.620),

vi. Sound ranking (t=-0.040, P=.968),

vii. Picture ranking (t=-0.510, P=.613),

viii. Color ranking (t=0.189, P=.851), and

ix. Text ranking (t=-0.806, P=.425), were not found significant.

Therefore, hypothesis 10 was not accepted.

The researcher tested the prediction of this hypothesis with "***learning activities***" and found the values of R=.247, R^2=.061, F (1, 48) =3.107, P=.084>.05 which accounted for 6.1% of the variance.

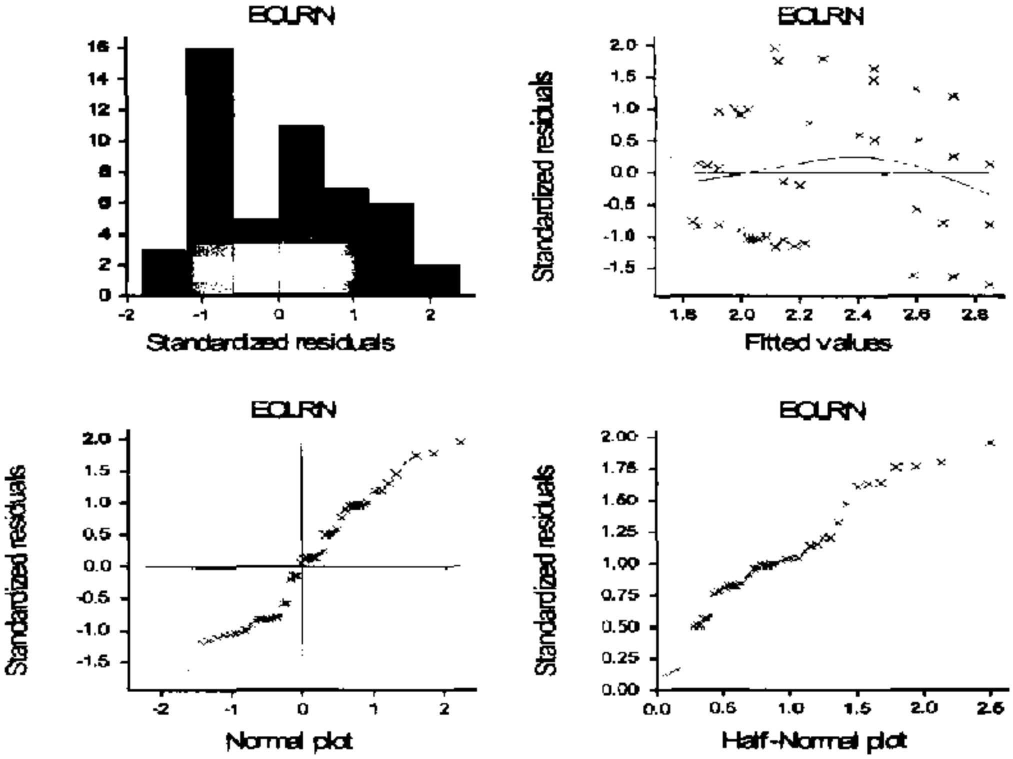


Figure (5.1.10, a) Influence of Learning Activities on the Learnability of the Digital Library

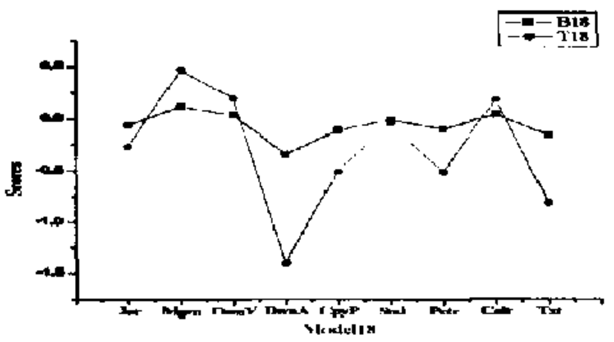


Figure (5.1.10, b) Influence of Learning Activities on the Learnability of the Digital Library

Influences of learning activities on the digital library learnability (H10)

The answer to RQ10 was not in affirmation.

The learnability of the digital library ensures that the students can learn the web site of any digital library rapidly. (Judy Jeng (2005a, 2005b) [30, 31]. Whereas, learnability according to Nielsen (2003)[46] depends upon how easy it is for the users to accomplish basic tasks the first time they encounter the design. The learnability in this study was determined by some procedures that the students should follow to accomplish basic tasks.

SECTION II: ANALYSIS OF THE STRUCTURAL MODEL BY USING AMOS 5

5.2.1) ANALYSIS OF THE STRUCTURAL MODEL

A structural equation modeling technique was used to test the learning assessment model. AMOS 5 program was employed for this purpose. To explain the relationship between indicator variables and latent variables and demonstrate the impact of these variables on each other, it is essential to understand structural equation modeling (SEM) and its analysis to help answer the questions that are still not answered.

5.2.1.1. Overview of Structural Equation Modeling (SEM)

Structural Equation Modeling (SEM) is a multivariate statistical technique, which incorporates and integrates multiple regression/ path analysis and factor analysis. SEM takes a confirmatory, rather than exploratory, approach to data analysis, which has several advantages over the traditional regression method of testing directional relationship between variables (Bryne, 2001[12]; Tabachnick & Fidell, 2001[54]; Kline, 2005[35]; Brown, 2006[11]; Meyers, Gamst, & Guarino, 2006[43]). In addition, in multiple regression and path analysis, each variable has only one indicator. Factor analysis is usually performed in a model in which each variable has multiple indicators but there are no causal effects (arrows) connecting the variables. However, SEM refers to a hybrid model with both multiple indicators or items measuring a variable (called latent variable or construct), and causal paths connecting the latent variable. SEM can simultaneously estimate all path coefficients and test the significance of each causal path, permitting the evaluation of the model performance as a whole by checking the overall goodness of fit of a hypothesized model rather than on testing coefficients, individually as multiple regression does (Bagozzi, 1981[4] & 1982[5]).

5.2.1.2) Structural Equation Modeling (SEM) Analysis

Bryne (2001)[12] asserts that a measurement model is a confirmative factor analysis and deals with relation of the indicator variables to the latent constructs while a structure model relates to the causal relationship of the latent variables and any additional observed or manipulated variables. AMOS 5.0 Graphics was used to run the structural model and test the hypothesized relationship between constructs. Maximum likelihood estimation was employed to compute structure coefficients between latent variables. Chi-square (X^2), Chi-square X^2/df, Goodness-of-Fit (GFI), Adjusted Goodness of Fit (AGFI), Comparative Fit Index (CFI), Root Mean Square Residual (RMR), and Root Mean Square Error of Approximation (RMSEA) were used to evaluate model fit (Joreskog & Sorbom, 1996[32]; Meyers, Gamst, & Guarino, 2006[43]). In addition, causal paths were interpreted as standardized coefficients in a regression analysis. Predictive power was examined with multiple correlations (R^2) for each endogenous variable.

Table (5.2.1.1) Level of significance for regression weight

			Estimate	*S.E.*	*C.R.*	*P*	*Label*
ACTIVITIES	<---	Learning	1.000				
USABILITY	<---	Learning	1.000				
USABILITY	<---	Activities	1.000				
ACTIVE_LEARNING	<---	Activities	-.717	.303	-2.370	.018	d_s
ACTIVE_LEARNING	<---	Usability	1.000				
EFFEC	<---	Usability	1.000				
INFOG	<---	Active_Learning	1.000				
EFFIT	<---	Usability	2.854	2.650	1.077	.282	viz_s
EFFM	<---	Usability	1.555	.541	2.874	.004	cub_s
SATIS	<---	Usability	-.967	.270	-3.580	.000	loan_s
LRNBTY	<---	Usability	.045	.215	.212	.832	zaed_s
INFOS	<---	Active_Learning	1.279	.272	4.696	.000	sert_v
ACNSM	<---	Active_Learning	-1.257	.418	-3.010	.003	ward_v

In the table (5.2.1.1) above, the probability of getting a critical ratio as large as 2.370 in absolute value was .018. In other words, the regression weight for Activities in the prediction of "***active learning***" was significantly different from zero at the .05 level (two-tailed). Therefore, the probability of getting a critical ratio as large as 2.874, -3.580, 4.696, and -3.010 in absolute values were .004, .000, .000, and .003 respectively. In other words, the regression weight for "***usability***" and "***active learning***" in the prediction of number of steps used to reach the answer of question "***efficiency***" (EFFM), students' "***satisfaction***" (SATIS), "***Information seeking***" (INFOS), and "***Active Consuming***" (ACNSM) respectively was significantly different from zero at the .05 level (two-tailed). The previous results supported the hypotheses 11, 13, 14, 16 and 17.

However, the probability of getting a critical ratio as large as 1.077 and 0.212 in absolute values were .282 and .832 respectively. In other words, the regression weight for "***Usability***" in the prediction of "***time spent***" (to reach the answer of the question), "***efficiency***" (EFFIT) and "***Learnablity***" (LRNBTY) were not significantly different from zero at the .05 level (two-tailed). These results did not support hypotheses 12 and 15 to ensure that the amount of "***time spent***" and "***usability***" would have a negative impact on students' "***activities***" and the levels of "***learnability***" and "***usability***" would have a negative impact on students' "***learning***". Hence, it can be noted that there is an interaction between the latent variables such as "***Activities***", "***Active Learning***", "***Usability***", and "***Learning***" with observed variables such as "***EFFIT, EFFM, SATIS, LRNBTY, INFOS,*** and ***ACNSM***", and together, which is the key goal of this research.

Table (5.2.1.2) Estimate of squared multiple correlations

	Estimate
ACNSM	.216
INFOS	.934
LRNBTY	.001
SATIS	.285
EFFM	.182
EFFIT	.026
INFOG	.412
EFFEC	.478

In the table (5.2.1.2) above, it was estimated that the predictors of "***ACNSM, INFOS, LRNBTY, SATIS, EFFM, EFFIT*** ", "***Information Gathering***" (INFOG), and "***Effectiveness***" (EFFEC) explained 21.6%, 93.4%, 0.1%, 28.5%, 18.2%, 2.6%, 41.2%, and 47.8% of its variance respectively.

For the learning assessment of digital library techniques, the Model is shown below in figure (5.2.1.1) using AMOS 5.0 Graphics with arrows representing causal relationships. The proposed structural model explained 27% of variance for the learning assessment.

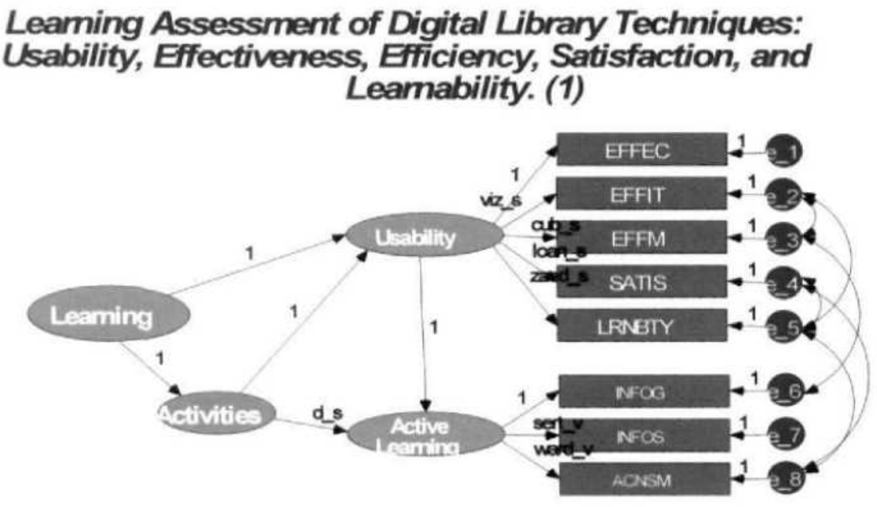


Figure (5.2.1.1) Learning Model

According to the model, "learning" as a construct can be expressed through "***learning activities***" and "***usability***" of the digital library. The "activities" can be expressed through active learning, which consisted of "***information gathering***" (INFOG), "***information seeking***" (INFOS), and "***active consuming***" (ACNSM). Whereas, usability of the digital library could be expressed through digital library attributes, such as "***effectiveness***" (EFFC), "***efficiency***" (EFFIT, or EFFM), "***satisfaction***" (SATIS), and "***learnability***" (LRNBTY).

5.2.1.3) Overall Goodness-of-Fit Statistics

The SEM is a statistical method to evaluate the plausibility of the proposed model (i.e., the relationships between the variables). The goodness-of-fit of the model is evaluated to compare the proposed model with the relationships existent in the actual or observed data. If the proposed model and the actual or observed relationship are consistent with each other, then the model fits the data and can be considered a credible explanation for the hypothesized relationships. Model fit indices are used as statistic to evaluate model fit. Over the past 20 years, at least 24 fit indices have been proposed (Klem, 2000[34]) and there is presently no general agreement on which measures are preferred. Researchers, therefore recommend the use of multiple fit criteria. The following model fit indices are commonly used as model fit criteria:

Table (5.2.3) Model Fit Indices.

Model Fit Indices	Symbols	Notes
Chi-square	X^2	(Joreskog & Sorbom,
Chi-square	X^2/df	1996[32]; Meyers, Gamst, &
Goodness-of-Fit	GFI	Guarino, 2006[43])
Adjusted Goodness-of-Fit	AGFI	
Norm Fit Index	NFI	
Comparative Fit Index	CFI	
Root Mean Square Residual	RMR	
Root Mean Square Error of Approximation	RMSEA	

Among them, Chi-square (X^2), Goodness-of-Fit (GFI), Root Mean Square Residual (RMR), and Root Mean Square Error of Approximation (RMSEA) are classified as absolute fit measures; and Adjusted Goodness-of-Fit (AGFI) parsimonious fit measure (Meyers, Gamst, & Guarino, 2006[43], p.559). X^2 value tests the difference between the proposed and the observed relationships. With this index, significant values indicate poor model fit, whereas nonsignificant values indicate good fit. While the X^2 is easily influenced by the sample size, the ratio of chi-square to its degree of freedom, X^2/df, is also used to indicate a good fit. It is suggested that a ratio of 3:1 or less indicates an adequate fit (Carmines & Maclver, 1981[13]). GFI is conceptually similar to the R^2 in multiple regression (Kline, 2005[35]). It measures the amount of variances and covariances jointly attributed to the model. The index ranges from 0 to 1, where 1 indicates a perfect fit. GFI should equal to or greater than 0.90 as indicative of an acceptable model (Hu, & Bentler, 1999[28]). RMR and RMSEA measure the average residuals between actual/ observed covariance and proposed/ expected model covariance. It is suggested that an RMR less than 0.09 and RMSEA less than 0.10 indicates that a model is acceptable (Hu, & Bentler, 1999[28]). CFI and NFI indicate the relative position between the independent model, which assumes that there are no relationships in the data (thus a poor fit), and the saturated model, which assumes a perfect fit. Both CFI and NFI are suggested to be greater than 0.90 for an acceptable model (Hu, & Bentler, 1999[28]). AGFI is the parsimonious adjusted goodness of fit and "corresponds to the GFI in replacing the total sum of squares by the mean sum of squares" (Meyers, Gamst, & Guarino, 2006[43], p.560). Ideally, values that are greater than 0.80 indicate an acceptable model (Hu, & Bentler, 1999[28]).

5.2.2) OVERALL GOODNESS-OF-FIT OF THE MODEL

A test was performed on the model as shown in the Figure (5.2.1.1) above and the following values were obtained: (see the following table)

Table (5.2.2.1). Report values of Model Fit

Reported values of Model Fit for the Structure Model

Model fit measures	Recommended values	Values from Model	Conclusion
Chi-square (X^2)	P>=.05	0.677	**Fit**
Chi-square (X^2)/df	<=3.00	0.794	**Fit**
Goodness-of-Fit (GFI)	>=0.90	0.946	**Fit**
Adjusted Goodness-of-Fit (AGFI)	>=0.80	0.861	**Fit**
Norm Fit Index (NFI)	>=0.90	**.917**	**Fit**
Comparative Fit Index (CFI)	>=0.90	1.000	**Fit**
Root Mean Square Residual (RMR)	<=0.09	0.0966	**Fit**
Root Mean Square Error of Approximation (RMSEA)	<=0.10	0.000	**Fit**

Research question No.11: Do the students' activities have influences on active learning?

Hypothesis No. 11: *The levels of activities will have a significant impact on active learning.*

The result was positive, therefore, the hypothesis11 was supported (P=.018<.05, see table (5.2.1.1) in this chapter) and answered RQ11.

Influences of Activities on Active Learning (H11)

The result was significant, as P=.018<.05. It was found that "***activities***" had a direct effect on "***learning***" (β=1.000) and had no indirect effect, whereas, "***active learning***" had only indirect effect on "***learning***" (β=1.000). The results of significant, direct, and indirect effects of "***activities***" and "***active learning***" on students' "***learning***" were supported by previous studies (Donghua Tao, 2008[21]; Adams et al, 1992[1]; Wixom & Todd, 2005[59]).

"***Activities***" and "***active learning***" play important roles in learning anytime and anywhere that raises the needs for suitable "***activities***" that help student to pass the education situation and motivate them to move to the next stage of learning. Learning can be seen as problem solving, as inquiry, as sense-making, as intellectual socialization, as design and as constructivist activity by which the learner builds his/ her own knowledge (Smith, 1993)[53].

Research Question No. 12: Does the usability have influences on the levels of time spent?

Hypothesis No. 12: *The usability will have a significant impact on the levels of time spent*

However, the result was unfortunately not significant which ensured that the hypothesis 12 was not supported ($P=.282>.05$, see table (5.2.1.1) in this chapter) and did not answer RQ12.

Influences of Usability on Time spent (H12)

The results as shown in table (5.2.3.1) in the finding of this study were not significant, as $P=.282>.05$ and the hypothesis 12 was not supported. However, the "***usability***" had a direct effect on "***activities***" ($\beta=0.500$) and the "***time spent***" had an indirect effect on "***activities***" ($\beta=0.081$).

These findings support Adams et al. (1992)[1] and Barry (1997)[6] empirical results and do not support the Judy Jeng (2005a, 2005b) [30, 31] empirical results. The reason may be that the students get some searching and browsing problems when using the digital library web site and the researcher suggests that students should get perfect training for searching the web sites and for seeking information rapidly in short-time.

Research Question No.13: Does the usability have influences on the levels of steps?

Hypothesis No. 13: *The usability will have a significant impact on the levels of steps*

The probability of this hypothesis was P=.004<.01 (see table (5.2.1.1) in this chapter) which meant that the hypothesis 13 was supported and answered RQ13.

Influences of usability on Number of steps (H13)

This result was significant with P=.004<.01 as shown in the table (5.2.3.1) in the last finding in this study. The "***number of steps***" had an indirect effect (β=0.427) whereas "***usability***" had a direct effect (β=0.500) and the indirect effect (β=0.500) on "***learning***" with total effect (β=1.000).

This result supports Adams et al. (1992)[1], Davis (1989a)[17], and Judy Jeng (2005a, 2005b)[30, 31] empirical results. The present study, the "***number of steps***" on students' "***learning***" did not have direct effect on "***learning***", which can be explained with one reason that all experiences of using the Internet resources the students selected and used were not enough and they should develop their skills in this part of using web site.

Research Question No. 14: Does the usability have influences on the levels of satisfaction?

Hypothesis No. 14: *The usability will have a significant impact on the levels of satisfaction*

The probability of value P=.000<.001 as mentioned in table (5.2.1.1) in this chapter indicated that this result is significant and answered RQ14. Therefore, the result supports the hypothesis 14.

Influences of Usability on the Satisfaction (H14)

The result was significant with P=.000<.001 and answered RQ14. However, the present study did not find the direct and indirect effect of both "***satisfaction***" and "***usability***" on "***active learning***", which was supported by the finding of the previous studies (Donghua, 2008[21]; Judy Jeng 2005a[30], 2005b[31]).

The result can be explained for two reasons. According to Jayawardana (2001)[29] the tools of the digital library can support "***active learning***" by integrating the user's personal library and remote digital library that students have. This means that the students with extra training on the digital library tools can search or browse the digital library easily; moreover, it will increase the interaction between the students and the digital library, which in turn increases students' "***satisfaction***".

However, according to Doughua (2008)[21] the students are motivated in large part by considering grades and receiving frequent feedback on their performance. It leads to support the "***usabillty***" (usefulness) of the digital library materials. Hence, it can be inferred that the students should be given some feedback on their performance of using the digital library and be encouraged for continuing learning.

Research Question No. 15: Does the usability have influences on the levels of learnability?

Hypothesis No. 15: *The usability will have a significant impact on the levels of learnability*

The result was unfortunately not significant and therefore ensured that the hypothesis 15 was not accepted (P=.832>.05, see table (5.2.1.1) in this chapter) and did not answered RQ15.

Influences of Usability on Learnability (H15)

This result was not significant with P=.832>.05. The "***learnability***" here had an indirect effort (β=0.032) on "***learning***", whereas, the "***usability***" had a direct effect and the indirect effect on "***learning***" (β=0.500 for each).

These finding did not support Judy Jeng (2005a, 2005b) [30, 31] empirical results. The reason was that some of the students could not follow the number of screen shots used in the map of steps rapidly at the first time, which caused technical problems such as failing of links between screen shots.

Research Question No. 16: Does the active learning have influences on the levels of information seeking?

Hypothesis No. 16: *The active learning will have a significant impact on the levels of information seeking*

Fortunately, the probability of the value was P=.000<.001 so this result was significant and led to accept the hypothesis 16 and answered RQ16.

Influences on Active Learning on Information Seeking (H16)

Since the result was significant P=.000<.001. The "***information seeking***" had an indirect effect on "***learning***" (β=0.966) and "***active learning***" had the indirect effect on "***learning***" (β=1.000). The reason for obtaining such a result may be that under different "***information seeking***" scenarios, the change in knowledge state could be attributed in different modes of searching and browsing (Choo, Detlor, & Turnbull, 2000[15]).

Research Question No. 17: Does the active learning have influences on the levels of active consuming?

Hypothesis No. 17: *The active learning will have a significant impact on levels of active consuming*

The probability of value P=.003<.01 as mentioned in table (5.2.1.1) in this chapter indicated that the result is significant and answered RQ 17. Therefore, the hypothesis 17 stands accepted.

Influences of Active Learning on Active Consuming (H17)

It may be concluded that "***active consuming***" had negative indirect effect on "***learning***" (β=-0.464), whereas, "***active learning***" had positive indirect effect on "***learning***" (β=1.000).

These results were similar to Dee, & Stanley (2005)[18] results in the part of "***information seeking***" as a part of "***active learning***" and similar to Jayawardana (2001)[29] empirical results.

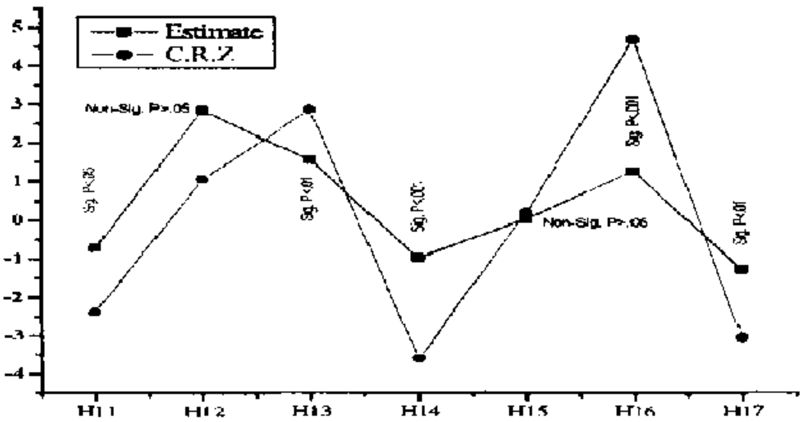


Figure (5.2.2.1) Hypotheses 11 – 17

5.2.3) DISCUSSION OF THE STRUCTURAL EQUATION MODELING

There were 19 causal paths in the final structure model with seven hypothesized causal paths associated with the domain knowledge construct (see Figure (5.2.3.1) in this chapter). Among these hypotheses, there were five hypotheses (71.43%) statistically significant. The statistical significance (Z value) was calculated by dividing the unstandardized regression weight by its standard error. At .001, .05 alpha (two tailed), causal path coefficients with Z value +1.96 or −1.96 or greater were statistically significant (Alistair W. Kerr, 2002). Table (5.2.3.1) presents the hypothesized relationships, standardized coefficient (Estimate), Z value (C.R.), and results see Figure (5.2.3.1) below.

Table (5.2.3.1) Results of Hypotheses Testing from Structure Model

Hypotheses	From	To	Estimate	S.E.	C.R.(Z)	P	Results
H11	Active_Learning	Activities	-.717	.303	-2.370	.018	Supported
H12	EFFIT	Usability	2.854	2.650	1.077	.282	Unsupported
H13	EFFM	Usability	1.555	.541	2.874	.004	Supported
H14	SATIS	Usability	-.967	.270	-3.580	***	Supported
H15	LRNBTY	Usability	.045	.215	.212	.832	Unsupported
H16	INFOS	Active_Learning	1.279	.272	4.696	***	Supported
H17	ACNSM	Active_Learning	-1.257	.418	-3.010	.003	Supported

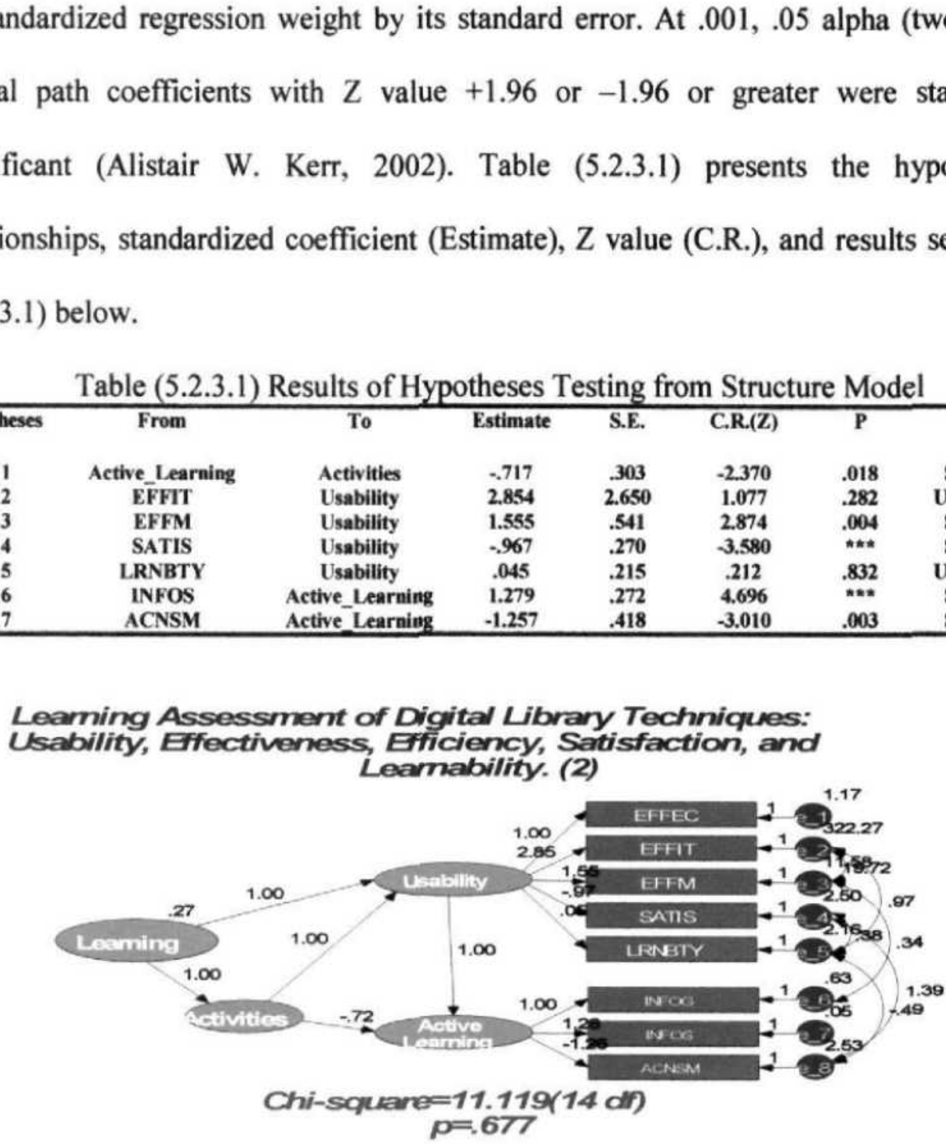


Figure (5.2.3.1) Unstandardized Estimation of Learning Model

Predictive Power (R^2):

The coefficient for determination indicated that the model explains 21.6% of the variance associated with "***active consuming***" (ACNSM), 93.4% associated with "***information seeking***" (INFOS), 1% associated with the "***learnability***" (LRNBTY), 28.5% associated with the students' "***satisfaction***" (SATIS), 18.2% associated with the "***efficiency***" of the digital library focused on the "***number of steps***" (EFFM), 2.6% associated with the "***efficiency***" focused on the time to reach the digital library materials (EFFIT), 41.2% of the variance associated with "***information gathering***" (INFOG), and 47.8% associated with the digital library "***effectiveness***" (EFFEC).

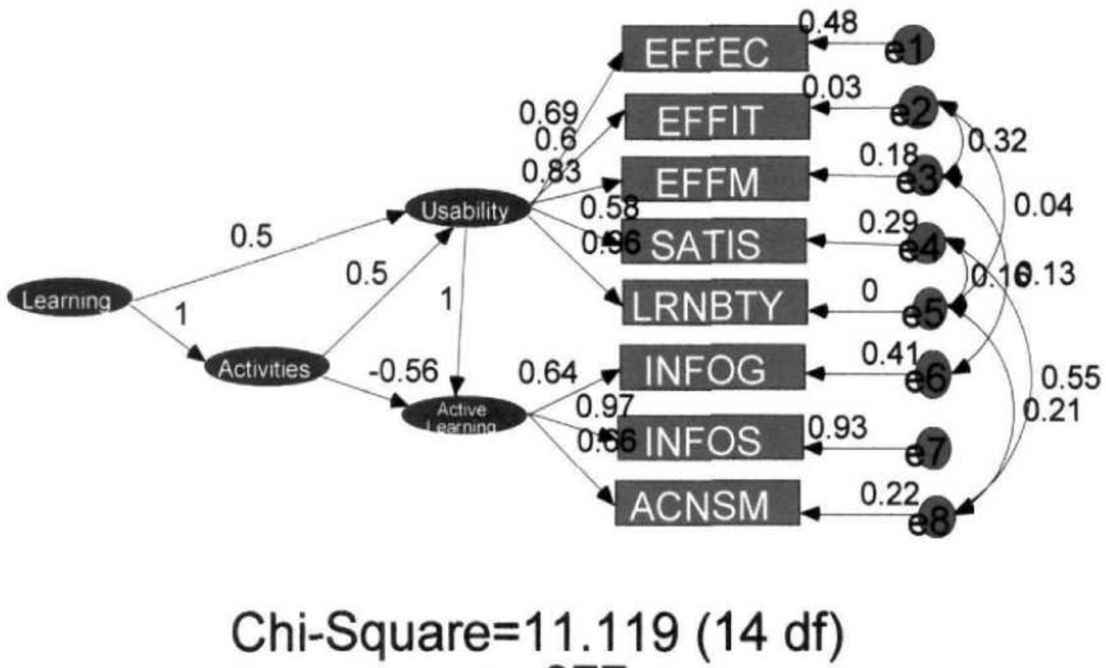


Figure (5.2.3.2) Standardized Estimation of Learning Model

Table (5.2.3.2a). Standardized Estemates (**Standardized Regression Weights**)

			Estimate
EFFEC	<---	Usability	.690
EFFIT	<---	Usability	.601
EFFM	<---	Usability	.826
SATIS	<---	Usability	.583
LRNBTY	<---	Usability	.955
INFOG	<---	Active_Learning	.643
INFOS	<---	Active_Learning	.966
ACNSM	<---	Active_Learning	.655

In table (5.2.3.2a) above it can be seen that the regression weights to be statistically significant.

Table (5.2.3.2b). Factor Loadings, Variance Extracted, and Reliability

	Usability	Active Learning		Item Reliability		Delta
EFFEC	.69			0.4761		0.52
EFFIT	.60			0.36		0.64
EFFIM	.83			0.6889		0.31
SATIS	.58			0.3364		0.66
LRNBTY	.96			0.9216	2.783	0.08
INFOG		.64		0.4096		0.59
INFOS		.97		0.9409		0.06
ACNSM		.66		0.4356	1.7861	0.56
	(2.783/5)*100	(1.7861/3)*100				
Variance Extracted	55.66	59.54				
Construct Reliability	0.86	0.81				

$$VE = \frac{\sum_{i=1}^{n} \lambda_i^2}{n}$$

$$CR = \frac{(\sum_{i=1}^{n} \lambda_i)^2}{(\sum_{i=1}^{n} \lambda_i)^2 + (\sum_{i=1}^{n} \delta_i)}$$

<u>Calculated Variance Extracted (AVE) from the table (5.2.3.2b):</u>

Usability Construct=0.4761+0.3600+0.6889+0.3364+0.9216=2.783/5=0.5566

Active Learning Construct=0.4096+0.9409+0.4356=1.7861/3=0.5954

<u>Discriminant Validity from the table (5.2.3.2b) and table (5.2.3.2c)</u>

	AVE	SIC
Usability	0.5566	0.0467, 0.1697, 0.08723
Active_Learning	0.5954	0.00001, 0.0812, 0.0331, 0.0007, 0.2285

It was noted that AVE for each construct >0.5, Construct Reliability (CR) > 0.7 and AVE > SIC for each factor. See **Appendix G for Convergent and Discriminant Validity.**

Table (5.2.3.2c) Squared Multiple Correlations

	Estimate
ACNSM	.216
INFOS	.934
LRNBTY	.001
SATIS	.285
EFFM	.182
EFFIT	.026
INFOG	.412
EFFEC	.478

5.2.3.1) Impact of Learning Activities and Usability on Learning

This section answers research question (RQ) 18.

RQ18: *Do the learning activities and usability have influences on the students' learning?*

While examining the direct effects of "***activities***" on "***learning***" the value obtained was β=1.000, whereas, the indirect effect of "***activities***" on "***learning***" was zero (β=.000). Therefore, the total effect of "***activities***" on "***learning***" was β=1.000. However, the examination of direct effects of "***usability***", "***active learning***", "***active consuming***" (ACNSM), "***information seeking***" (INFOS), "***learnability***" (LRNBTY), "***satisfaction***" (SATIS), "***efficiency***" for steps (EFFM), "***efficiency,***" for time (EFFIT), "***information gathering***" (INFOG), and "***effectiveness***" (EFFEC) on "***learning***" were β=.500, .000, .000, .000, .000, .000, .000, .000, .000, and .000 respectively (see table (5.2.3.3) below).

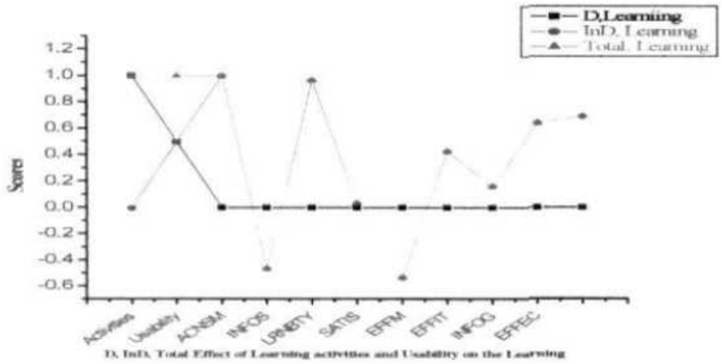


Figure (5.2.3.3). Direct, Indirect, and Total effect of learning activities and usability on learning

Table (5.2.3.3) Direct, Indirect, and Total effect of learning activities and Usability on the learning

	Direct Effect	Indirect Effect	Total Effect
	Learning	Learning	Learning
Activities	1.000	.000	1.000
Usability	.500	.500	1.000
Active Learning	.000	1.000	1.000
ACNSM	.000	-.464	-.464
INFOS	.000	.966	.966
LRNBTY	.000	.032	.032
SATIS	.000	-.534	-.534
EFFM	.000	.427	.427
EFFIT	.000	.162	.162
INFOG	.000	.642	.642
EFFEC	.000	.691	.691

Whereas, the indirect effect for them were β=1.000 for "***active learning***" and also same for "***active consuming***" (ACNSM) on "***learning***", β=.966 for "***information seeking***" (INFOS) on "***learning***", β=.032 for "***learnability***" (LRNBTY) on "***learning***", β=.-534 for "***satisfaction***" (SATIS), β=.427 for "***efficiency***" using the "***number of steps***" (EFFM), β=.162 for "***efficiency***" time (EFFIT), β=.642 for "***information gathering***" (INFO), and β=.691 for "***effectiveness***" on "***learning***".

Finally, the total effects of "***activities***", "***usability***", "***active learning***", "***active consuming***" (ACNSM), "***information seeking***" (INFOS), "***learnability***" (LRNBTY), "***satisfaction***" (SATIS), "***efficiency***" for steps (EFFM), "***efficiency***" for time (EFFIT), "***information gathering***" (INFOG), and "***effectiveness***" (EFFEC) were β=1.000, β=1.000, β=1.000, β=-.464, β=.966, β=.032, β=-.534, β=.427, β=.162, β=.642, and β=.691 respectively.

From the previous results it could be inferred that activities, "***usability***" of the digital library, and "***active learning***" had the strongest total effect (β=1.000) on "***learning***", followed by "***infarmation seeking***" (β=.966), then by "***effectiveness***" of using the digital library materials (β=.691), and finally by "***information gathering***" (β=.642).

5.2.3.2) Impact of Learning Activities and Usability on Activities

This part of the study tried to answer the research question 19.

RQ19: *Do the learning activities and usability have influences on the students' activities?*

In this part, the direct, indirect, and total effects of "***usability***", "***active learning***", "***active consuming***", "***information gathering***", "***learnability***", and "***satisfaction***",

efficiency were examined on the "***number of steps***", "***efficiency***"(time), "***information gathering***", and "***effectiveness***".

The results of direct effect, "***usability***" was found to be β=.500, of "***active learning***" the direct effect was β=-.559, and of the reminding attributes of the digital library materials the direct effects were the same with the value of β=.000.

Secondly, the obtained value of indirect effect of "***usability***" on "***activities***" was β=.000, of "***active learning***" on "***activities***" was β=.779, of "***active consuming***" on "***activities***" was β=-.102 of "***information seeking***" on "***activities***" was β=.213, of "***learnability***" on "***activities***" was β=.016, of "***satisfaction***" on "***activities***" was β=-.267 of "***efficiency***" using the "***number of steps***" on "***activities***" was β=.213 of "***efficiency***" of time on "***activities***" was β=.081 of "***information gathering***" on "***activities***", was β=.141 and of "***effectiveness***" on "***activities***" was β=.346.

Finally, the obtained values of total effects were β=.500 for "***usability***", β=.221 for "***active learning***", β=-.102 for "***active consuming***", β=.213 for "***information seeking***", β=.016 for "***learnability***", β=-.267 for "***satisfaction***", β=.213 for "***efficiency***" of steps, β=.081 for "***efficiency***" of time, β=.141 for "***information gathering***", and β=.346 for "***effectiveness***" on "***activities***".

Therefore, it could be inferred that "***usability***" (β=.500) had the strongest total effect on "***activities***", followed by "***effectiveness***" of using the digital library materials (β=.346), then by both "***information seeking***" and "***efficiency***" of using the "***number of steps***" to reach the digital library materials (β=.213). See table (5.2.3.4) below:

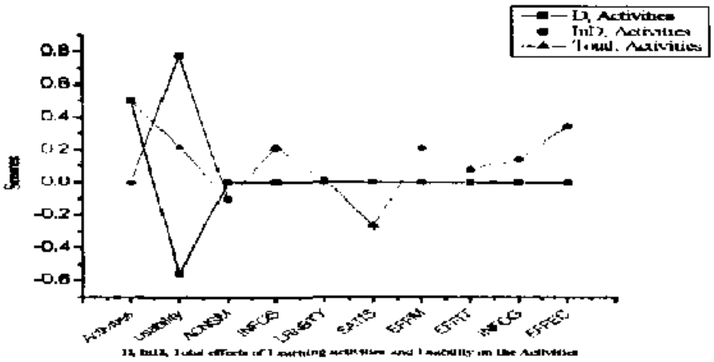


Figure (5.2.3.4) Direct, Indirect, and Total effect of learning activities and Usability on the activities

Table (5.2.3.4) Direct, Indirect, and Total effect of learning activities and Usability on the activities

	Direct Effect Activities	Indirect Effect Activities	Total Effect Activities
Usability	.500	.000	.500
Active Learning	-.559	.779	.220
ACNSM	.000	-.102	-.102
INFOS	.000	.213	.213
LRNBTY	.000	.016	.016
SATIS	.000	-.267	-.267
EFFM	.000	.213	.213
EFFIT	.000	.081	.081
INFOG	.000	.141	.141
EFFEC	.000	.346	.346

5.2.3.3) Impact of Learning Activities and Activities on Digital Library Usability

This section answers the Research Question20.

RQ20: *Do the learning activities and students' activities have impacts on the digital library usability?*

The direct, indirect, and total effects of "***activities***" and "***active learning***" on "***usability***" can be explained as follows: first, the direct effect of "***activities***" on "***usability***" was expressed by β=.000, whereas, it was β=1.559 for "***active learning***", β=.000 for "***active consuming***", again β=.000 for "***information seeking***", β=.032 for "***learnability***", β=-.534 for "***satisfaction***", β=.427 for "***efficiency***" in the "***number of steps***" to reach digital library materials, β=.162 for "***efficiency***" of time, β=.000 for "***information gathering***", and β=.691 for "***effectiveness***".

In the same way, the values obtained for indirect effects were as follows: for "***activities***", "***active learning***", "***learnability***", "***satisfaction***", "***efficiency***" of steps, "***efficiency***" of time, and "***effectiveness***" the values found were β=.000), of "***active consuming***" β=-.724, "***information seeking***" β=1.507 and "***information gathering***" β=1.000.

Similarly, the values obtained for total effects were β=.000 for "***activities***", β=1.599 for "***active learning***", β=-.724 for "***active consuming***", β=1.507 for "***information seeking***", β=.032 for "***learnability***", β=-.534 for "***satisfaction***", β=.427 for "***efficiency***" of steps, β=.162 for "***efficiency***" of time, β=1.000 for "***information gathering***", and β=.691 for "***effectiveness***" on "***usability***".

An overview of these results can lead to conclude that "***active learning***" had the strongest effect on the "***usability***" of the digital library (β=1.559), followed by "***information seeking***" (β=1.507), thereafter by "***information gathering***" (β=1.000), and finally by "***effectiveness***" (β=.691).

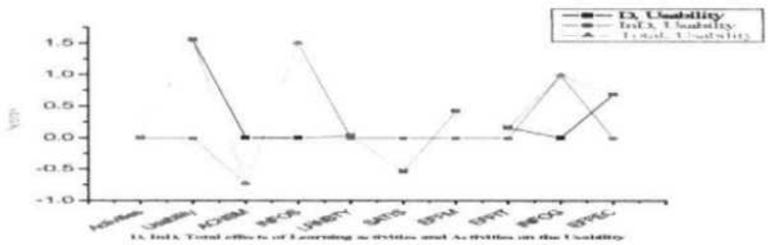


Figure (5.2.3.5). Direct, Indirect, and Total effect of learning activities and activities on the Usability

Table (5.2.3.5) Direct, Indirect, and Total effect of learning activities and activities on the Usability

	Direct Effect	Indirect Effect	Total Effect
	Usability	Usability	Usability
Activities	.000	.000	.000
Active Learning	1.559	.000	1.559
ACNSM	.000	-.724	-.724
INFOS	.000	1.507	1.507
LRNBTY	.032	.000	.032
SATIS	-.534	.000	-.534
EFFM	.427	.000	.427
EFFIT	.162	.000	.162
INFOG	.000	1.000	1.000
EFFEC	.691	.000	.691

5.2.3.4) Impact of Learning Activities and Usability on Active Learning

This section answers RQ21.

RQ21: *Do the learning activities and usability have influences on students' active learning?*

It could be noticed that the obtained value of direct effect of "***activities***", "***usability***", "***learnability***", "***satisfaction***", "***efficiency***" of steps, "***efficiency***" of time, and "***effectiveness***" was same and came to be β=.000, whereas, the obtained values of the direct effects of "***active consuming***", "***information seeking***", and "***information gathering***". were β=-.464, β=.966 for β=.642 respectively.

On the other hand, it could be said that the digital library attributes had no indirect effects for the value β=.000 was noted in all the cases. See the table (5.2.3.6) below.

Finally, the total effects of these variables were as follows: "***activities***", "***usability***", "***learnability***", "***satisfaction***", "***efficiency***" of steps, "***efficiency***" of time, and "***effectiveness***" were β=.000. Whereas, β=-.464 for "***active consuming***", β=.966 for "***information seeking***", and β=.642 for "***information gathering***".

Hence, it could be inferred that the "***information seeking***" had the strongest total effect (β=.966) on the "***active learning***" followed by "***information gathering***" (β=.642).

Table (5.2.3.6) Direct, Indirect, and Total effect of Activities and Usability on the Active Learning

	Direct Effect	Indirect Effect	Total Effect
	Active Learning	Active Learning	Active Learning
Activities	.000	.000	.000
Usability	.000	.000	.000
ACNSM	-.464	.000	-.464
INFOS	.966	.000	.966
LRNBTY	.000	.000	.000
SATIS	.000	.000	.000
EFFM	.000	.000	.000
EFFIT	.000	.000	.000
INFOG	.642	.000	.642
EFFEC	.000	.000	.000

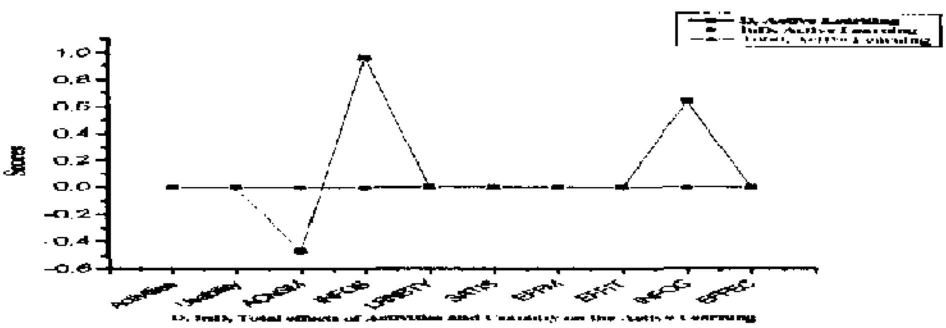


Figure (5.2.3.6). Direct, Indirect, and Total effect of Activities and Usability on the Active Learning

Therefore, H9, H10, H11, H16 and associated RQs 9, 10, 11, 16, 17, 18, 19, 20 and 21fulfilled the second objective of this study which addressed to evaluate the digital library techniques.

SECTION III: ANALYSIS OF THE STUDENTS' COMMENTS

Table (5.3.1) Students' Comments for Attributes of Usability

	OrgInfo	Trmnlogy	Attrct	Mis	Racin	Lost	Nvgt
Mean	2.5000	2.6400	2.3400	2.6400	2.7400	1.3200	1.6200
Std. Deviation	.81441	.77618	.84781	.98478	.87622	.47121	.49031

5.3.1) ORGANIZATION OF INFORMATION (1=FULL CLEAR, 5=FULL UNCLEAR)

According to students' responses the information was clearly organized and easy to look at things.

5.3.2) TERMINOLOGY (1=FULL CLEAR, 5=FULL UNCLEAR)

The subjects evaluated the terminology to be straightforward, understandable, clearly described and explanatory.

5.3.3) ATTRACTIVENESS (1=FULL ATTRACTIVE, 5=FULL UNATTRACTIVE)

The subjects evaluated attractiveness of DLs with respect to color, graphics, readability to be simple and with attractive font features.

5.3.4) MISTAKE RECOVERY (1=FULL EASY, 5=FULL DIFFICULT)

The students found the system, easy to navigate and the back option helping them to get the correct pathway.

5.3.5) OVERALL REACTION (1=FULL SATISFIED, 5=FULL UNSATISFIED)

The Likert scale was used in Post-Test. This scale gave the students another opportunity to rate the test sites and provided overall reaction after examining specific areas, such as ease of use, organization of information, terminology, attractiveness, and mistake recovery.

5.3.6) LOST-NESS (1=NO, 2=YES)

It was found that the students felt lost because of the site design for the first time they used it, but while using it, for next time and ahead, they felt more comfortable.

5.3.7) NAVIGATION (1=NO, 2=YES)

Subjects' comments regarding navigation indicated that links should be stable and self-explanatory.

5.3.8) EXPECT CORRECT ANSWER

Seventy-five percent (75%) of students who participated in this study indicated that a click supported them to get what they could expect.

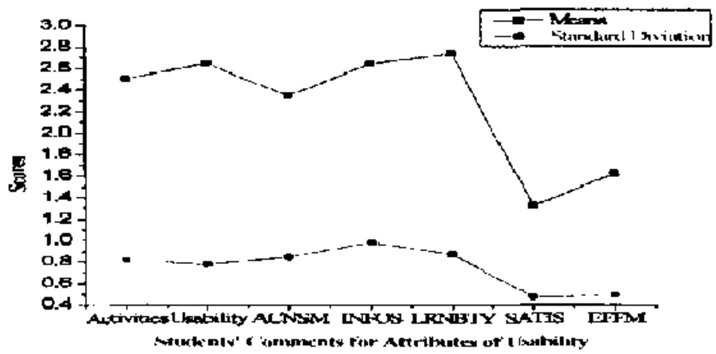


Figure (5.3.1) Students' Comments for Attributes of Usability

REFRENCES

[1] Adams, D. A., Nelson, R. R., & Todd, P. A. (1992). Perceived usefulness, ease of use, and usage of information technology: A replication. *MIS Quartely, 16(2)*, 227-247.

[2] Andy Dong and Alice M. Agogino (2001). Design principles for the information architecture of a SMET Education Digital Library *In IEEE/ACM Joint Conference on Digital Libraries.* Roanoke, VA, USA. Available at URL: www.engineeringpathway.com/smete/public/about_smete/publications/JCDL-0601/dongagoginojcdl01-01.pdf.

[3] Arpit Jan (2008). Intinno: A Web integrated digital library and content management system. Thesis. Indian Institute of Technology Kharagpur. April 2008.

[4] Bagozzi, R. P. (1981). Evaluating structural equation models with unobservable variables and measurement error: A comment. *Journal of Marketing Research, 18(3)*, 375-381.

[5] Bagozzi, R. P. (1982). A field investigation of causal relations among cognitions, affect, intentions, and behavior. *Journal of Marketing Research, 19(4)*, 562-583.

[6] Barry, C. A. (1997). The research activity timeline: A qualitative tool for information research. *Library & Information Science Research, 19(2)*, 253-179.

[7] Blandford, A., & Buchanan, G. (2002). Workshop report: Usability of Digital Libraries @ JCDL'02. SIGIR Forum, 36 (2), 83-89.

[8] Blandford, A., & Buchanan, G. (2003). *Usability of digital libraries: A source of creative tensions with technical developments.* TCDL Bulletin. Retrieval April 12, 2009 from: http://www.ieee.tcdl.org/Bulletin/v1n1/blandford/blandford.html.

[9] Borgman, C. L., Leazer, G. H., Gilliland-Swetland, A. J. & Gazan, R. (2000). Evaluating digital libraries for teaching and learning in undergraduate education: A case study of the Alexandria digital earth prototype (ADEPT). *Library Trends, 49(2)*, 228-250.

[10] Brockman, W. S., Neumann, L., Palmer, C. L., Tidline, T. J. (2001). Scholarly work in the humanities and the evolving information environment. Digital library federation and council on library and information resources (CLIR), Washington, DC.

[11] Brown, T. A. (2006). *Confirmatory Factor Analysis for Applied Research*. New York: The Guilford Press.

[12] Bryne, B. M. (2001). Structural equation modeling with AMOS: Basic concepts, application, and programming. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

[13] Carmines, E., & Maclver, J. (1981). Analyzing models with unobserved variables: Analysis of covariance structure. In G. Bohmstedt, & E. Borgatta (Eds.), *Social Measurement: Current Issues*. Beverly Hills, California: Sage.

[14] Chen, N. (2006). A survey of indexing and retrieval of multimodal documents: text and image, technical report, 2006-505, Queen's University.

[15] Choo, C. W., Detlor, B., & Thurnbull, D. (2000). Information seeking on the web: An integrated model of browsing and searching. First Monday, 5 (2).

[16] Collins, L. M., Mane, K. K., Martinez, M. L. B., Hussell, J. A. T., & Luce, R. E. (2005). ScienceSifter: Facilitating activity awareness in collaborative research groups through focused information feeds. *In First international conference on e-Science and grid computing* (pp. 40–47). Melbourne, Australia: IEEE Computer Society, December 5–8.

[17] Davis, F. D. (1989a). Perceived usefulness, perceived ease of use, and acceptance of information technology. *MIS Quarterly, 13(3)*, 319-340.

[18] Dee, C. & Stanley, E. E. (2005). Information-seeking of nursing students and clinical nurses: Implications for health sciences library. *Journal of Medical Library Association,* 93(2).

[19] Del Bimbo A. (1999). *Visual Information Retrieval*, Morgan Kaufmann Publishers, San Francisco, Calif.

[20] Dillon, A., & Gabbard, R. (1998). Hypermedia as an educational technology: A review of the quantitative research literature on learner comprehensive, control and style. Review on Educational Research, 68(3), 322-349.

[21] Donghua Tao (2008). Using theory of reasoned action (TRA) in understanding selection and use of information resources: An Information resource selection and use model. PhD. Dissertation, Faculty of the Graduate School, University of Missouri, Columbia.

[22] Druin, A., Bederson, B., & Hourcade, J. P. (2003). Designing a digital library for young children: An intergenerational partnership. In E. Fox, & C. Borgman

(Eds.), *Proceedings of ACM/IEEE Joint Conference on Digital Libraries* (pp. 398-405). Roanoke, VA: ACM Press.

[23] Fine, S. (1984). Research and the psychology of information use. *Library Trends, 32 (4)*, 445-446.

[24] Fuentes, C. A. (2003). The use of corpora and IT in a comparative evaluation approach to oral business English. *RecCALL, 15(2)*. PP. 189-201.

[25] Hansen, P., & Ja"rvelin, K. (2005). Collaborative information retrieval in an information-sensitive domain. *Information Processing and Management, 41*, 1101–1119.

[26] Haralick, R. M. (1979). Statistical and structural approaches texture, *Proceedings of the IEEE*, Vol. 67 (5), pp. 786-804.

[27] Horea Todoran (2002). *The road to real multimedia database emerging multimedia data types*. STUDIA UNIV. BABES-BOLYAI, INFORMATICA, Volume XLVII, Number 2.

[28] Hu, L. & Bentler, P. M. (1999). Cutoff criteria for indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1-55.

[29] Jayawardana C., K. P. Hewagamage and M. Hirakawa. (2001). Database Systems Lab, Graduate School of Information Engineering, Hiroshima University. *MC Journal of Academic Media Librarianship*, v.8#1, summer 2001.

[30] Jeng, J. (2005a). Usability assessment of academic digital libraries: Effectiveness, Efficiency, Satisfaction, and Learnability. *LIBRI, 55(2-3)*, 96-121.

[31] Jeng, J. (2005b). What is usability in the context of digital library and how can it be measured? *Information Technology and Libraries 24(2)*, 47-56.

[32] Joreskog, K. G., & Sorbom, D. (1996). LISREL 8 User's Reference Guide. Chicago: Scientific Software International.

[33] Kassim, A. R. C., & Kochtanek, T. R. (2003). Designing implementing, and evaluating an educational digital library resource. *Online Information Review*, 27 (3), 160-168.

[34] Klem, L. (2000). Structural equation modeling. In L. Grimm & P. R. Yarnold (Eds.), *Reading and understanding MORE multivariate statistics* (pp. 227-260). Washington, DC: American Psychological Association.

[35] Kline, R. B. (2005). *Principles and practice of structural equation modeling* (2nd ed.). New York: The Guilford Press.

[36] Kuhlthau, C. C. (1993). Seeking meaning A process approach to library and information services. New Jersey: Ablex Publishing Corporation, Norwood.

[37] Manjunath, B. S. and Ma, W. Y. (1996). Texture features for browsing and retrieval of image data, *IEEE Transactions on pattern Analysis and Machine Intelligence* 18 (19): 837-842.

[38] Marchionini, G. (1989a). Information seeking strategies of novices using a full-text electronic encyclopedia. *Journal of the American Society for Information Science, 40 (1)*, 54-66.

[39] Marchionini, G., Plaisant, C., & Komlodi, A. (2003). The people in digital libraries: Multifaceted approaches to assessing needs and impact. In A. P. Bishop, B. Buttenfield & V. H. N. (Eds.), Digital library use: social practice in design and evaluation. Cambridge: The MIT Press.

[40] McCown, F., Bollen, J., & Nelson, M. L. (2005). Evaluation of the NSDL and Google for obtaining pedagogical resources. *In Proceedings of the ECDL 2005*. Lecture notes in computer science 3652 (pp. 344-355).

[41] McNally, M. J. & Kuhlthau, C. C. (1994). Search process in science education. Reference Library, 44 (1), 53-60.

[42] Mehrotra, R. and Gary, J. E. (1995). Similar-shape retrieval in shape data management, *IEEE Computer* 28 (9): 5762.

[43] Meyers, L., S., Gamst, G., & Guarino, A. J. (2006). Applied Multivariate Research: Design and Interpretation. Thousand Oaks, CA: Sage Publication, Inc.

[44] Michael G. Christel, David B. Winkler, C. Roy Taylor (1997). Multimedia abstractions for a digital video library. *In Proceedings of ACM Digital Libraries '97 Conference*, Philadephia, PA, pp.21-29.

[45] Michal Kosiedowski, Cezary Mazurek, Maciej Stroinski, Marcin Werla, Marcin Wolski (2007). Federating digital library services for advanced applications in

science and education. *Computational Methods in Science and Technology* 13(2), 101-112 (2007).

[46] Nielsen, J. (1993). Usability Engineering. San Diego, CA: Academic Press.

[47] O'Hara, K. O., Smith, F., Newman, W., & Sellen, A. (1998). Student readers' use of library documents: implications for library technologies. *In Proceedings of CHI'98*, pp. 233-240.

[48] Picard, R. W. and Minka, T. P. Vision texture for Annotation, technical report, MIT Media Laboratory, No. 302. available at http://citeseer.nj.nec.com/picard95vision.html.

[49] Plass, J. L., & Homer, B. D. (2002). Cognitive load in multimedia learning: The role of learner preferences and abilities. Paper accepted for presentation at the International Conference on Computers in Education (ICCE) in Auckland, New Zealand.

[50] R. Kengeri, C. D. Seals, H. P. Reddy, H. D. Harley, and E. A. Fox (1997). Usability study of digital libraries: ACM, IEEE-CS, NCSTRL, NDLTD, December 1997. http://fox.cs.vt.edu/~fox/u/Usability.pdf. (9 June 2009).

[51] Rui, Y., and Huang, T. S. and Chang S. F. (1999). Image retrieval: Current Techniques, Promising Directions and Open Issues. *Journal of Visual Communication and Image Representation* 10 (4): 39-62.

[52] Shneiderman, B. (1998). Designing the user interface strategies for effective human-computer interaction (3rd ed). Reading, MA: Addision-Wesley.

[53] Smith, D. A. A., R. J., J. P. (1993). Misconceptions reconceived: A constructivist analysis of knowledge in transition. Journal of the Learning Sciences, 3 (2).

[54] Tabachnick, B. G., & Fidell, L. S. (2001). Using multivariate statistics (4th ed). Boston, MA: Allyn & Bacon.

[55] Tamura, H., Mori, S., Yamawaki, T. (1978). Textual features corresponding to visual perception, *IEEE Trans.* On System, Man and Cybernetics 8 (6).

[56] Tane, J., C. Schmit, G. Stumme. S. Staab & R. Studer (2003). The Courseware Watchdog: an Ontology-based tool for finding and organizing learning material. In Fachtagung Mobiles Lernen and Forschen.

[57] Windschitl, M. (1998). The WWW and classroom research: what path do we take? *Educational Researcher*, 27(1), 28-33.

[58] Windschitl, M. (2000). Using the WWW for teaching and learning in k-12 classrooms: what are the interesting research questions? *cyberPsychology & Behavior*, 3 (1), 89-96.

[59] Wixom, B. H., & Todd, P. A. (2005). A theoretical integration of user satisfaction and technology acceptance. *Information Systems Research, 16(1)*, 85-102.

[60] W. K. Alistair, Hall H., A. K. Stephen (2002). Doing Statistics with SPSS (1st ed). SAGE Publications, London, Thousand Oaks, New Delhi.

[61] Wu, S. and Witten, I. H. (2006). Towards a digital library for language learning. *Proc European Conf. on Digital Libraries*, Pp. 341-352, Alicante, Spain.

CHAPTER 6

CONCLUSIONS AND SUGGESTIONS

6.1 CONCULSIONS

Digital libraries store materials in electronic format and manipulate large collections of those materials effectively. Research into digital libraries is research into network information systems, concentrating on how to develop the necessary infrastructure to mass manipulate the information on the Net. Witten (2002)[54] indicated to digital library as a collection-building tool. The social aspect of digital libraries emphasizes the activities people engage in when they create, seek, and use information resources. Adachi (2000)[1] presented NACSIS-ELS, a digital library system of Japanese academic journals. Furthermore, many projects were launched for using digital libraries in different fields in the world such as Information Digital Video Library; Illinois Digital Library Project; Alexandria Digital Library Project; University of Michigan Digital Library Project (UMDL); University of Berkeley Digital Library Project; the Stanford Digital Library Project; University of California CD-ROM Information System; and British Library's Initiative for Access. Digital libraries (Fox E. A., et al., 1995[16]; Levy & Marshall, 1995[34]) have been developed to efficiently organize, store, and provide access to the rapidly increasing amount of digital information.

Some features of digital libraries had been discussed, such as, i) Digital libraries are organizations with specific objectives or goals. [UNECA (2003)[49].] ii) Digital libraries are made up of digital collections. iii) Digital libraries serve a defined community or set of communities. iv) Digital libraries are set-up to serve users, and the information needs of the target community or set of communities determine the information content and services of the digital library. Users through a single user-friendly interface access digital libraries. Documents of a digital library are available in digital format. Digital libraries are to be used by individuals working alone.

Furthermore, the advantages of digital libraries have been emphasized by Rama Nand Malviya, (2008)[40] such as, digital libraries provide access to much richer content in a more structured manner, Digital libraries can provide very user-friendly interface, giving clickable access to its resources, whereas, traditional libraries are limited by storage apace, digital libraries have the potential to store much more information, simple because digital information requires very little physical space to contain them. The cost of maintaining a digital library is lower than that of a traditional library. Digital libraries' information resources are available for access to users around the clock. UNECA (2003)[49] also pointed out to the infrastructure requirements for digital libraries, such as, availability of appropriate information and communication infrastructure on which the digital library will be built, availability of standards which manage the digital information resources. For good quality information resources, databases, and effectiveness of information searching and retrieval, electronic information management standards should be employed.

Evaluation of digital libraries is an essential component for the design of effective digital libraries. Digital libraries are designed for users so more user friendly techniques should be developed in this field. The present research, therefore, concentrated on assessment of some of the digital library techniques from users' perspectives and tried to answer the research questions.

The digital library promotes learning through personal ownership and management of the learning process while connecting the learner with the content and communities of learners and educators. The use of information and communication technologies to support learning activities (a field now known as education technology) has fostered the educational digital libraries (EDL). Digital library unites rather than divides. Therefore, there is a need of present time to develop and promote digital libraries.

In order to enhance learning through distant mode Yemen established the first digital collection of information, called The National Information Center as first step to construct a digital library in Yemen. (see http://www.yemen.nic.info.)

The terms such as usability, active learning, and digital libraries are important in this research and are defined by renowned authors in this area of research. For example, International Standards Organization (ISO)[23], Judy Jeng (2005a, 2005b) [25, 26], and Nielsen (1993)[38] definition were considered for "usability"; IBM (1994)[21], Lesk (1997) cited by Malvia, R. N., 2008)[33], Waters (1992)[52], Lynch et al. (1995)[35], Berkeley (1994) cited in Larson, Ray R., 1994[32]), Witten & Bainbridge (2002)[54], were considered for "Digital library".

The main objectives of this study were to explore various techniques of learning by using digital library; evaluate these techniques of digital library; and hightlight the need for education by using the digital library techniques.

It has been found by literature review that some researchers have concentrated on the digital library design, attributes, and extract information such as Wu and Witten (2006)[55], Dong and Agogino (2001)[2], etc., whereas, others concentrated on studying educational digital library as specific digital libraries and specific users, (e.g., Digital Library for Earth System Education (DLESE), MathDL, BiosciEdNet (BEN), and the

MicrobeLibrary). In addition, some researchers have analyzed the usability of the digital libraries such as Xie (2008)[56], Teal Anderson and Sayeed Chouhdury (2008)[45], Zani-Sabihi, Ghinea and Chen (2006)[14], Judy Jeng (2005a, 2005b) [25, 26], etc.

Learning technology standards specify learning object metadata and interoperability. This research concentrated on the evaluation of Berkeley Digital Library with respect to its usability attributes and learning activities of the learners. With respect to digital materials, three actions create the tools for active learning (Active consuming, Information Gathering, and Information Seeking). Questionnaire which consisted of three parts was a research tool developed by the investigator. Different statistical techniques and statistics programs were used in this research such as multiple regressions with backward methods, normality, reliability, factor analysis using SPSS 17.0 Program. Structural equation modeling techniques were used by applying AMOS 5 Program which determined the relationship between the latent variables and observed variables and detected the direction of the impact of some variables toward others. The core of this study was to study the influences among "effectiveness, efficiency, and satisfaction"; "efficiency & satisfaction"; "effectiveness & satisfaction"; "learning activities, usability, and the ease of use"; "experience of using the Internet & Internet; "learnability of the digital library & ease of learn"; "time spent, number of steps required for using the digital library materials, and satisfaction"; "learning activities, satisfaction, and learnability"; "activities, active learning, and learning"; "time spent, number of steps, usability, and activities"; "satisfaction, usability, and active learning"; "learnability, usability, and learning"; "information seeking, active learning, and learning"; and "active consuming, active learning, and learning".

A model and suite of instruments were designed and successfully tested.

Given the fact that digital objects carry information in digital libraries and their respective metadata specifications, the proposed dimensions of quality for these two concepts can be connected to the life cycle of information in digital libraries (Borgman, 1996[4]). Information seeking and learning processes cannot be separated (Cole, 1999[8]; Marchionini, 1995[10]). Therefore, the relationship between information seeking and learning, and digital libraries, information seeking and learning were discussed.

Digital libraries extend such interdisciplinary approach by making diverse information resources available beyond the physical space shared by groups of learners. Digital libraries open new learning opportunities for global rather than just local communities. Many of the data sets and computational tools of digital libraries were originally developed to enhance professional learning. Digital libraries combine technology and information resources to allow remote access, breaking down the physical barriers between resources. Digital learning material provides many opportunities to provide an authentic learning content. Especially, digital learning materials provide many opportunities to engage each student individually in studying. Digital learning materials provide several opportunities to prevent cognitive overload. Digital libraries are potentially highly interactive environments encouraging electronic learning between its users (Microsoft, 2003[37]; Jose et al., 2002[28]; Kearsley, 2000[29]).

Today, active learning is a highly discussed issue; it brings students into the process of their own education taking them beyond the role of passive listener and note taker, and allowing the student to take some direction and initiative in classroom instruction (Jayawardana, 2001[24]). Teachers can distribute lecture notes and other required materials via the Web. Learners then get the opportunity to use learning materials freely and independently, collecting other related materials on the Web as well (Dodge, 1996; cited in Jayawardana, 2001[24]). At the same time the digital library is a machine readable representation of materials over the Internet, which might be found in a University library together with organizing information, intended to help users find specific information, well managed, and supports searching of digital objects. It should be looked as a set of tools and objects that support students' learning and information task. Students are looking for learning materials or an information that are easy and intuitive to use or important to study. This study considered both reading activities with static digital library materials and listening/watching activities with audio-visual library materials. Active consuming is a composition of active reading, active listening, and active watching. It discussed the information gathering (copying, downloading, etc.) and information seeking (searching, browsing, navigating, etc.) in the contexts of the digital library and provided tools that play role in improving activities in any learning environment. It applied student-centered formal learning and usability testing techniques to measure learning activities from the perspectives of active consuming, information gathering, and information seeking; also to measure usability from the perspectives of effectiveness, efficiency, satisfaction, and learnability that considers both performance elements as well as satisfaction.

In the research model, learning construct was selected that leads to learning activities and usability of the digital library. Most of the hypotheses were tested, verified and accepted.

The following conclusions have been drawn upon the results which were obtained after statistical analysis of the data.

I Conclusions based on relationships between ***effectiveness, efficiency and satisfaction*** (research question 1 and hypothesis No. 1):

i. RQ1: Do the effectiveness and efficiency of using the digital library materials have influences on students' satisfaction?
ii. H01: ***The levels of effectiveness (of digital libraries) will have a significant impact on learner's efficiency and satisfaction*** (table No. 5.1.3).

The students were found satisfied with searching documents or papers that were available in BDL and did many tasks such as copying and reading these papers or e-books.

II Conclusion based on relationships between ***efficiency and satisfaction*** (research question 2 and hypothesis No. 2) :

i. RQ2: Does the efficiency of using the digital library materials have influences on students' satisfaction?
ii. H02: ***The levels of efficiency will have a significant impact on learner's satisfaction*** (tables No. 5.1.4, 5.1.5 and 5.1.6).

The students were satisfied with searching documents and videos that were available in BDL, performed many tasks such as copying and reading these papers or e-books, and also downloading videos and watching some videos, and performed multi-tasks such as abstracting and extracting important information.

On the other hand, students were not satisfied with searching audios and listening to them because of the reason that they might be more interested in reading papers, documents, e-books, and watching videos for different subjects but they have less interest in listening to audios.

III Conclusion based on relationships between ***effectiveness and satisfaction*** research question 3 and hypothesis No. 3:

i. RQ3: Does the effectiveness of using the digital library materials have influences on students' satisfaction?
ii. H03: ***The levels of effectiveness will have a significant impact on learner's satisfaction*** (table No. 5.1.7).

The results led to conclude that the students were satisfied with searching texts available in word document or papers and did many tasks such as copying and reading these papers or e-materials.

The reasons behind the above finding may be that the students had experienced Web Sites such as Google, Yahoo, etc. in their University. They used to visit Internet café and searched for some information through papers or e-books to complete their learning tasks.

IV Conclusion based on ***learning activities & usability and satisfaction*** research question 4 and hypothesis No. 4:

i. RQ4: What are the influences of learning activities and usability on the ease of use of the digital library?
ii. H04: ***The levels of learning activities and usability will have a significant impact on ease of use of the digital library*** (table No. 5.1.8).

The digital library is a place that provides a set of integrated tools based on individual user's requirements and interests with respect to his access to digital library materials. These tools support active learning and usability of the digital library techniques by integrating the learner's personal library and a remote digital library.

V Conclusion based on relationships between ***Experience and Internet*** research question 5 and hypothesis No. 5:

i. RQ5: What are the differences between students' experience and using Internet?

ii. H05: ***The levels of learner's experience will have a significant impact on using the Internet*** (table No. 5.1.9).

It was concluded that, the students heavily relied on the Internet for their academic activities. It was also noted that there were differences between students' experience and using Internet because of differences of interests & preferences, availability of information under one site, time, variety of resources to collect data and human communication.

VI Conclusion based on relationships between ***Learnability*** research question 6 and hypothesis No. 6:

i. RQ6: What are the influences of the digital library learnability on the ease of learn?
ii. H06: ***The levels of digital library learnability will have a significant impact on ease of learn of the digital library*** (table No. 5.1.10).

The results led to conclude that, learnability is the most fundamental digital libraries' usability attribute. The digital library system should be made easy to learn and should guarantee good performance so that the students can rapidly start getting some work with the digital library system. It can also be noted that, the learnability of the BDL had positive impact and major influences on ease of learn as mentioned in this study.

VII Conclusion based on relationships between ***Time spent & ease of the system*** research question 7 and hypothesis No. 7:

i. RQ7: What are the influences of the time spent for using the digital library on students' satisfaction?
ii. H07: ***The levels of time spent using the digital library will have a significant impact on learner's satisfaction*** (tables No. 5.1.11, 5.1.12 and 5.1.13).

It can be noted that, the hypothesis holds true in the category of "looking for papers or e-books" but in the category of "search for videos", the results were not so, because of the fact that motivation led students to spend more time with large satisfaction. The downloading of a video will take time rather than copying text. However, the watching of video gave positive impact and greater satisfaction. Though, downloading audio also takes some time but less than downloading video, however, the listening to an audio decreases students' satisfaction which means more time spent, less satisfaction.

It can further be noted that, the time spent in searching for BDL has positive impact and strong influences on students' satisfaction (on text and video), but negative and weak influences on audio.

VIII Conclusion based on relationships between ***Number of steps & ease of the system*** research question 8 and hypothesis No. 8:

i. RQ8: Can the number of steps of using the digital library materials lead to the full students' satisfaction?
ii. H08: ***The levels of steps to reach the digital library materials will have a significant impact on learner's satisfaction*** (tables No. 5.1.14, 5.1.15 and 5.1.16).

It can be noted that, the number of steps involved in searching BDL has positive impact and strong influences on students' satisfaction (video) but negative and weak influences in text and audio categories.

When students see a video and have opportunities to interact with the educator or teacher, they are more satisfied; however, when they listen to an audio or read text, they find it tiring. An active conversation is more satisfying than a silent conversation.

IX Conclusion based on relationships between ***Learning activities & ease of the system*** research question 9 and hypothesis No. 9:

i. RQ9: What are the influences of learning activities on students' satisfaction?
ii. H09: ***The levels of learning activities will have a significant impact on the learner's satisfaction*** (tables No. 5.1.17, 5.1.18 and 5.1.19).

Learning activities cover most of the part of this study. These activities such as searching, browsing, listening, watching, reading, copying, downloading etc. are increasing day by day with education changing situations of education. It was found that more activities led to larger satisfaction but fewer activities led us to lesser satisfaction.

X Conclusion based on relationships between ***Learning activities & ease of learn*** research question 10 and hypothesis No. 10:

i. RQ10: What are the influences of learning activities on learnability of the digital library?
ii. H010: ***The levels of learning activities will have a significant impact on the digital library learnability*** (table No 5.1.20).

The results led to conclude that learning activities had negative impact and weak influences on learnability of the BDL.

XI Conclusion based on relationships between ***Activities and active learning*** hypothesis No. 11:

i. H011: ***The levels of activities will have a significant impact on the active learning*** (table No. 5.2.1.1).

It can be noted that activities and active learning had positive impact on learnability of the BDL

XII Conclusion based on relationships between ***Time spend, usability & activities*** hypothesis No. 12:

i. H012: ***The usability will have a significant impact on amount of time spent*** (table No. 5.2.1.1).

According to the obtained results, the time spent and usability had negative impact on students' activities while using BDL.

XIII Conclusion based on relationships between ***usability & Number of steps*** hypothesis No. 13:

H013: ***The usability will have a significant impact on the levels of steps*** (table No. 5.2.1.1).

The number of steps and usability showed a positive impact on learning of the BDL.

XIV Conclusion based on relationships between ***usability & Satisfaction*** hypothesis No. 14:

i. H014: ***The levels of satisfaction and usability will have a significant impact on active learning*** (table No. 5.2.1.1).

The results led to conclude that satisfaction and usability had positive impact on active learning of the BDL.

XV Conclusion based on relationships between ***usability & Learnability*** hypothesis No. 15:

i. H015: ***The levels of learnability and usability will have a significant impact on learner's learning*** (table No. 5.2.1.1).

Learnability and usability showed a negative impact on learning of the BDL

XVI Conclusion based on relationships between ***active learning & Information seeking*** hypothesis No. 16:

i. H016: ***The levels of information seeking and active learning will have a significant impact on learner's learning*** (table No. 5.2.1.1).

Information seeking and active learning had positive impact on learning of the BDL

XVII Conclusion based on relationships between ***active learning & Active consuming*** hypothesis No. 17:

i. H017: ***The levels of active consuming and active learning will have a significant impact on learner's learning*** (table No. 5.2.1.1).

Active consuming and active learning had positive impact on learning of the BDL.

Note: Hypotheses No. 11, 13, 14, 16 and 17 supported the answer for questions No. 11, 12, 13, 14, 15, 16 and 17.

XVIII Conclusions based on the analysis of students' comments for the attributes of *Usability*

The following conclusions are based on students' comments regarding the usability (table No. 5.3.1):

i. The organization of the digital library's content was straightforward and easy to look up at things.
ii. The terminologies too were straightforward, understandable, clearly described and explanatory.
iii. The attractiveness of color, graphics, and readability were not complicated and were found suitable with regard to font features.
iv. The students perceived the system to be easy to navigate and with the back option that helped them to get the correct pathway.
v. The overall reaction of students led to conclude that they were fully satisfied with ease of use, organization of information, terminologies, attractiveness and mistake recovery.
vi. The students felt bored with the site design in the first instance, but when used it the next time and more, they felt comfortable.
vii. The subjects' comments regarding navigation indicated that links should be stable and self-explanatory.
viii. Most of the students who participated in this study indicated that a click was enough to simply get what they could expect.

According to Jayawardana (2001)[24] the tools of the digital library can support active learning by integrating the user's personal library and remote digital library that students have a lack of these tools. This means that the students with extra training on the digital library tools can search or browse the digital library easily; therefore, this will increase the interaction between the students and the digital library, which further increases students' satisfaction. It leads to support the usability (usefulness) of the digital library materials.

From the results it could be inferred that activities and usability of the digital library, and active learning had the strongest total effect (β=1.000) on learning, followed by information seeking (β=.966), and then by effectiveness of using the digital library materials (β=.691), and finally by information gathering (β=.642).

In the last part of the study, the researcher discussed the implications of the findings in different categories, such as traditional pedagogical shift, teacher preparation and curriculum reform, teacher professional development and policy reform, equality of educational opportunities for all students. The suggestions for future researches were also discussed and submitted for future researchers.

6.2 EDUCATIONAL IMPLICATIONS OF THE FINDINGS

The present study found most of usability attributes to have positive impact on learnability and learners' satisfaction. Learning activities had also positive impacts, such as impact of activities and active learning on students' learning; impact of information seeking and active learning on students' learning; impact of active consuming and active learning on students' learning.

System designers and developers must acknowledge that a system's ease of use is dependent on any particular task context (Keil, et al., 1995[30]). To ensure a system's usability and learning activities, system designers and developers should start with a clear understanding of learners' requirements and needs. However, it is important to gain a clear understanding of how and why teachers and students are using technology, what is the need for traditional pedagogical shift? What are the needs in teachers' preparation and curriculum reform? How they can be effective in teachers professional development and policy reform, and for providing equality of educational opportunities for all students.

In order to integrate technology in schools, teacher education programs play a crucial role. Teacher preparation on technologies should provide teachers with a solid understanding of various media, their affordance, and constraints. Such understandings can only emerge when teachers are actively involved in teaching and learning with technology across the various disciplines. It is essential to look at teachers' backgrounds, their comfort level with technology, the affordances associated with the specific technology, and the human and technological infrastructure.

6.2.1 NEED FOR TRADITIONAL PEDAGOGICAL SHIFT

Technology skills should be taught as part of curriculum. One can learn how to use a computer while working on a meaningful task. Teacher preparation should not be based on training for "computer literacy" but should prepare teachers for using technologies to construct, represent, and share knowledge in real life contexts. Teachers should be taught about how to use technology for constructing, organizing, and communicating knowledge (Barron, Goldman, 1994[3]). The history of technology use in education shows that the first inclination is to use new technology in the same traditional ways as the old technology (Cuban, 1986[11]; Means, 1994[36]).

The digital libraries (DLs) today are a result of an advanced technology. These DLs include different resources that help teachers and students to improve their educational skills. Therefore, teachers should get training on how they could use DLs such as browsing, navigation, and searching their materials. Old curricula and pedagogical approaches should be reformed, and if necessary replaced, to take advantage of the affordances of the new media (Vrasidas C. & McIsaac M., 2001[51]). Learning is a result of construction, collaboration, reflection, and negotiation within a rich context in which learning is situated (Brown, Collins, & Duguid, 1998[5]). Technology has the potential to support constructivist learning and be used for active, authentic, and cooperative activities (Jonassen, Peck, Wilson, 1999[27]). Harasim (1995)[20] opined that computer-mediated education facilitated educational approaches, which shifted the focus from "knowledge transmission to knowledge building" (p. 205). Knowledge building results when learners interact with their peers, collaborate, discuss their ideas, form arguments, and negotiate meaning. Information technologies and computer networks shift the role of the teacher from knowledge transmitter to that of facilitator who provides opportunities for interaction and meaning making to all learners.

Additionally, in a teacher education course, a variety of evaluation technologies can provide information about the learners' thinking processes, self-reflective skills, performance in completing real-world authentic tasks, and ability to identify technology solutions to instructional problems. Traditional tests can also be used but they should not be the only method of evaluation. Other evaluation techniques include the collection of students' projects and assignments, students' self-evaluations, reflective journals, and class presentations of sample lessons (Vrasidas C. & McIsaac M., 2001[51]).

6.2.2 TEACHER PREPARATION & CURRICULUM REFORM

In a course on educational technology for teachers, the goal should not simply be to teach the use of several technology systems, their advantages, and disadvantages. Instead, the goal should be to provide students with opportunities to think like experts in making instructional decisions, selecting media for appropriate use, structuring learning activities, and employing sound pedagogical strategies in real-life contexts. Furthermore, teacher preparation programs should not simply offer a course in educational technology, but also demonstrate effective use of technology in teaching teachers several other courses.

Constructivist approach and uses of technology in teaching should be modeled in the teaching of other subject matters such as mathematics education, science education, and social studies. For instance, in science education, future teachers should be taught with technology in ways that model appropriate technology-based learning for science education.

Several rich interactive multimedia systems exist in the market that allow students to work in groups to review video vignettes of classroom teaching, identify good practices, and discuss them with peers. At Arizona State University, the teacher preparation programs for both in-service and pre-service teacher training on mathematics methods make extensive use of an interactive multimedia program called Mathedology (Technology Based Learning & Research, 1998[46]). Mathedology is based on a digital library of classroom video depicting primary teachers teaching mathematical concepts using the National Council of Teachers of Mathematics' (NCTM) professional standards on discourse. The program includes video episodes of elementary mathematics teachers modeling the NCTM professional standards on discourse, expert commentary in audio format, content based on the NCTM Curriculum and Evaluation Standards, and animations of mathematical concepts. Students can view the video vignettes of teachers and discuss them with peers. Mathedology provides a rich content for teachers to develop an understanding of appropriate mathematics teaching in primary schools. Such multimedia systems provide all students and teacher a common and rich content for discussion, much richer than text descriptions of settings. In addition students can listen to teachers shown in vignettes and understand what math educators and other experts have to say about the teaching strategies used in the video episode (Vrasidas C. & McIsaac M., 2001[51]).

The BDL has the same features of the Mathedology but with several subjects such as Chemistry, Biology, Microbiology, Education, Physics, English, Arts, Medical ...etc. Its rich-environment allows prospective teachers to experience real-life scenarios of classroom teaching, construct multiple perspectives, and reflect on their practice. BDL programs include video, audio, animation, encyclopedia, news, graphics, text, communication canalization ... etc. that provides multiple conversations between both teachers and students, teachers together, and students together.

6.2.3 TEACHER PROFESSIONAL DEVELOPMENT AND POLICY REFORM

According to Ertmer (2005)[15], "It takes five to six years for teachers to accumulate enough expertise to use technology in ways advocated by constructivist reform efforts" (p. 27). To integrate technology in teaching, pre-service teachers need to be well prepared, but also in-service teachers need to deepen their knowledge and skills as well. In-service teachers need time to develop, master, and reflect on technology-based learning approaches. They need time and incentives to participate in lifelong professional development. In addition, students need training to use these technologies to construct their knowledge in flexible ways and in a short time. Digital libraries will help teachers and students to value and encourage up-to-date knowledge, skills, and qualifications. However, a skills-based or competency-based compensation pay system might be a better way to value and reward teacher knowledge and skills. Students in this study used BDL and found it quick and accurate. As digital libraries improve their techniques, students and teachers will increase their use of digital libraries. Findings from this study suggest that creators of digital libraries should remember their target audience, teachers and students, and should not forget their original goal of creating materials that are, ideally, core-related, age-appropriate, interactive, engaging, aesthetically pleasing, and accountable.

6.2.4 EQUALITY OF EDUCATIONAL OPPORTUNITIES

Timothy E. Morse (2004)[47] discussed the multidimensional meaning of the term digital divide as: (a) the effect of this phenomenon as it relates to equality of educational opportunity for all students and (b) ways to address it. The reason every student must develop basic technology literacy skills is that the use of computer technology is becoming increasingly commonplace in every facet of society. Even though computer technology is being used more frequently throughout society, its use is not equitable among the social groups in society, a circumstance that could result in negative outcomes for students with limited access to computer technology. Thus, the inequitable use of computer technology has been referred to as the digital divide.

According to Gorski (2002)[19], this learn "has traditionally described inequalities in access to computers and the Internet between groups of people based on one or more social or cultural identifiers" (p. 28), such as race or gender. Brown[5] and colleagues stated that schools attended by students from diverse ethnic backgrounds as well as students from families living in poverty are likely to offer less access to most types of technology. If every student is to be afforded an opportunity to develop basic technology literacy skills, the first issue that must be addressed is eliminating the inequities that exist with respect to each student's access to the computer technology. Simply stated, if a student is to learn how to use computer technology, he must first have ready access to it (Collins, 1991; Kozma & Croninger, 1992[9]). Brown (2000)[6] noted that there is an emphasis in some inner city schools to use computer technology to enable students to acquire basic academic skills, whereas in schools those are more affluent it is used to develop the students' critical, higher-order thinking skills. As such, Clark and Gorski (2001)[7] challenged educators to think about how they will use technology with their students before doing so and specifically noted that educators should juxtapose the issues of what can be done with technology and what should be done with it. However, administrators and policy makers need to set clear agendas regarding the educational and curriculum goals they would like to achieve with the help of new technology innovations.

Literature on educational change reveals that teachers facilitate integration of such innovations into daily classroom realities (Sarason, 1971[41]; Popkiewicz, 2000[39]). To avoid such a situation, policy makers and administrators implementing educational innovations need to adopt a model that will blend the top-down and bottom-up strategies (Fullan, 1993[17]) because, as Fullan[17] argued, effectiveness of educational change depends on the level of coordination between these two strategies. Within such a model, policy makers and administrators must give teachers "agency" (Sarason, 1971[41]) in both the planning and implementation of an innovation. This "agency" as Fullan and Stiegelbaur (1991)[18] argued, should not be based on administrators' assumptions that teachers were involved because they had been placed on major committees or project teams. True teacher involvement takes place when teachers are engaged in every stage of educational change, including goal setting and planning, budget and curriculum designing, and implementation of innovation (Wiburg, 1997[53]).

Teachers also need to be provided with more opportunities for control within their own classrooms system. To help teachers in this respect, administrators can provide teachers with display devices and central monitoring systems that will allow them to determine the times students may access technology and the time they may not, as well as the degree of access with regard to Internet and digital libraries sites. Administrators, policy makers, and teacher educators also need to recognize that school-wide and college technology initiatives are a complex process that involve far more than putting computers in classrooms. Individuals in charge of implementing innovations need to realize that teacher, like students, are comprised of "different type of learners who cannot be treated the same way" or expected to "progress at the same pace when integrating technology into their individual practice (Snoeyink & Ertmer, 2001-2002)[43] (p.104).

6.2.5 OTHER IMPLICATIONS

In the light of findings of the present research work the followings implications have been suggested:

1 Establish the DL web site for education purpose in Universities and colleges because DLs are beneficial for distance education that allows multi-directional interaction between students and teachers and students with each other. DLs can incorporate a variety of multimedia elements such as text, graphics, audio, video, animation, etc. The incorporation of these communication mediums has the potential to address all students' learning style; both instructors and students are able to author and publish their work to a global audience, and the posting of the students' projects, papers, and other student work may be used for modeling, discussion, and review in DLs (See DL Principles, Dong & Agogino, 2001)[2].

2 To help learn and use technology in general and specifically DLs for instructional purpose, there is a need to provide assistance to existing teachers by a professional staff member or a teacher colleague to increase comfort and productivity levels. Show concrete curricular items that would benefit more with the use of digital libraries (DLs) and computer technology rather than traditional tools, and make opportunities to observe constructivist ways of teaching with technology in other teachers' practice to show other than word processing, note taking. Moreover, teacher-led-technology uses must be created as well as more student-centered learning environments in their universities or schools must be created. (See Use of Hypertext, Snyder, 1998)[44].

3 To help students learn and use technology and DLs. they need to be prevented from the digital divide on economic grounds. Administrators who implement digital library initiatives need to make such digital libraries open to every student free of charge. Students need early training on DLs web site to support the learnability of the DLs (See Diognene Project, Vergara et al., 2003[50]).

4 Flexible training schedules and several course materials are needed (See Diognene Project, Vergara et al., 2003[50]).

5 DLs collection should meet the users' information needs as well as provide easy access to users (See Topic-Map based system, Dicheva & Dichev, 2004[13]).

6 Library as a place needs to make sure that there are enough computers for students to use; printers and photocopiers are all usable; the network is connected, and the ready-to-serve on-site technical assistance is available (See Pathway Project, Steven Scott et al., 2007[42]; ensuring equality of educational opportunity in the digital Age, Timothy E. Morse, 2004[47]).

6.3 SUGGESTIONS FOR FUTURE RESEARCH

This research extends the following suggestions for future researches:

i. The study was primarily conducted on Undergraduate English Language students in Taiz University. Not much is known about the use of DLs at other levels of education, so future researches may conduct studies on other levels of education than undergraduate level. If learning and EDLTs is to fully be assessed, additional studies on undergraduates in other disciplines with different backgrounds need to be conducted.

ii. Researches may be conducted on topics such as, the effect of DLs on the learning and teaching. This research has pointed out that Digital Library Techniques (DLTs) have influences on learning. Additional studies that focus on DLs to assess the learning will help clarify the degree to which Digital Libraries affect students' education and learning methods, approaches or any other educational aspects. Further studies may be conducted to clarify the potential relationship between professional development activities and experience.

iii. The current research relied on quantitative data only. Students of other subjects may interpret the terms describing learning and DLTs that were used in the instrument differently. Thus, it is recommended that future studies couple the questionnaires with classroom observations and analysis of documents related to the participants' teaching, such as syllabi and handouts.

iv. A more granular approach to investigate into various aspects of learning assessment may be applied.

v. Use of other demographic informations as variables of interest may provide a more clear picture of learning of undergraduates of English Language who are using DLs. For example, this research did not investigate into differences based on gender and age. Focus on variables such as these may add to understand of what currently appears to be individual differences among students.

vi. Researches related to the impact of institutional support on the education and diffusion of technology may clarify the role of institutional grants to support the scholarship of teaching, and learning or the impact of departmental support on learning and education through DLs.

vii. Finally, instruments used in this study may be valuable tools for others studying similar problems, therefore, further testing and refinement of these instruments could be taken as topics of future researches in this field.

6.4 SUMMARY

This dissertation consists of six (6) chapters arranged as follows: in chapter 1, the researcher described the digital library's concepts, features, advantages and the impact of technology on education and learning. It stated the problem and research questions, significance of the study, objectives, hypotheses, and definition of important terms.

In chapter 2, literature review was discussed related to digital libraries, problems issues and challenges of the digital libraries and their usability. In chapter 3 a detailed description of the conceptual framework has been presented, for instance, in section 1, the researcher discussed the multimedia information retrieval and communication, its model, elements, and media interaction. Secondly, information retrieval, content-based image retrieval, and hypertext and hypermedia conceptualization were also discussed. In section 2 of this chapter, the framework of information-seeking, relationships between learning, information seeking, and digital libraries, and scaffolding and personalization have been given.

The chapter 4 described in detail the research design, population and sample, research tools, data collection, and statistical techniques. The reliability, validity of the instrument, preliminary findings of the pilot study, factor analysis, and normality were also explained.

The next chapter (5) concentrated on data analysis and its interpretation. The results of the study and the related key findings were demonstrated which were mostly positive and fulfilled the objectives of the study.

Finally, in chapter 6, the implications of findings were discussed and the needs for changes in the field of education according to these study findings were indicated. The chapter concluded with important points with the perspective of the research findings and some previous studies and conclusions were drawn accordingly. In the end a few suggestions were made for future researches in this area of Educational technology.

REFERENCES

[1] Adachi, J. (2000). NACSIS-ELS: Digital library of Tapanese academic journals. *In Proceedings of the 3rd International Conference on Asian Digital Library,* (pp. 15-22). Seoul, Korea.

[2] Andy Dong and Alice M. Agogino (2001). Design principles for the information architecture of a SMET Education Digital Library *In IEEE/ACM Joint Conference on Digital Libraries.* Roanoke, VA, USA. Available at URL: www.engineeringpathway.com/smete/public/about_smete/publications/JCDL-0601/dongagoginojcdl01-01.pdf.

[3] Barron, L. C., & Goldman, E. S. (1994). Integrating technology with teacher preparation. In B. Means (Ed.), *Technology and Education Reform* (pp. 57-81). San Francisco, CA: Jossey-Bass.

[4] Borgman, C. L. (1996). Social aspects of digital libraries. In: E. A. Fox & G. Marchionini (Eds.), *Proceedings of the 1st ACM International Conference on Digital Libraries* pp. (170-171). Bethesda, MD.

[5] Brown, J. S., Collins, A., Duguid, P. (1998). Situated cognition and the culture of learning. *Educational Researcher, 18,* 32-42.

[6] Brown, M. R. (2000). Access, instruction, and barriers: Technology issues facing students at risk. *Remedial and Special Education, 21,* 182-192.

[7] Clark, C., & Gorski, P. (2001). Multicultural education and the digital divide: Focus on race, language, socioeconomic class, sex, and disability. *Multicultural Perspectives, 3*(3), 39-44.

[8] Cole, C. (1999). Activity of understanding problem during interaction with an "enabling" information retrieval system: Modeling information flow. *Journal of American Society for information Science*, 50 (6), 544-552.

[9] Collins, A. (1991). The role of computer technology in restructuring schools. *Phi Delta Kappan, 73,* 28-36.

[10] Cory Marchionini and Hermann Maurer (1995). The role of digital libraries in teaching and learning. *Communication of the ACM, April 1995/vol. 38,* No.4.

[11] Cuban, L. (1986). *Teachers and machines: The classroom uses of technology since 1920.* New York: Teachers College Press.

[13] Dicheva, D. & C. Dichev (2004). A framework for Concept-based digital course libraries. *Journal of Interactive Learning Research, 15 (4)*. 347-64.

[14] Elahe Zani-Sabihi, Gheorghita Ghinea, & Sherry Y. Chen (2006). Digital libraries: what dousers want? *Online Information Review 30 (4)* (2006): 395-412.

[15] Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration. *ETR&D-Educational Technology Research and Development, 53*(4), 25-39.

[16] Fox, E. A., Akscyn, R. M., Furuta, P. K. and Leggett, J. J. (1995). Digital libraries communications of the ACM, 38 (4), 22-28.

[17] Fullan, M. (1993). *Change forces: Probing the depths of educational reform.* Bristol, PA: The Falmer Press, Taylor & Francis Inc.

[18] Fullan, M., & Stiegelbauer (1991). *The new meaning of educational change* (2nd ed.). New York, NY: Teachers Chollege, Columbia University.

[19] Gorski, P. C. (2002). Dismantling the digital divide: A multicultural education framework. *Multicultural Education, 10*(1), 28-30.

[20] Harasim, L., Hiltz, S. R., Teles, L., & Turoff, M. (1995). *Learning networks: A field guide to teaching and learning online*. Cambridge, MA: MIT Press.

[21] IBM. (1994). *Digital libraries: gross structure and requirement creport from the workshop.* [Online] available (Accessd 9 July 2009) www: http://www.ifla.org/documents/libraries/net/rj9840.pdf.

[23] ISO/IEC JTCI/SC29/WG11/W3703 MPEG-7 (2000). Multimedia content description interface part3 visual.

[24] Jayawardana C., K. P. Hewagamage and M. Hirakawa. (2001). Database Systems Lab, Graduate School of Information Engineering, Hiroshima University. *MC Journal of Academic Media Librarianship*, v.8#1, summer 2001.

[25] Jeng, J. (2005a). Usability assessment of academic digital libraries: Effectiveness, Efficiency, Satisfaction, and Learnability. *LIBRI, 55(2-3)*, 96-121.

[26] Jeng, J. (2005b). What is usability in the context of digital library and how can it be measured? *Information Technology and Libraries 24(2)*, 47-56.

[27] Jonassen, D. H., Peck, K. L., & Wilson, B. G. (1999). *Learning with technology: A constructivist perspective*. Upper Saddle River, NJ: Prentice-Hall.

[28] Jose, J. M., Braddick, H. Martin, I., Robertson, B., Walker, C., & Macpherson, G. (2002). Virtual tutor: A system for deploying digital libraries. In E. P. Lim, S. Foo, C. Khoo, H. Chen, E. Fox, S. Urs & T. Costantino (Eds.), *Proceedings of 5th International Conference on Asian Digital Libraries* (pp. 275-286). Germany, Springer.

[29] Kearsley, G.(2000). Learning and teaching in cyberspace. Canada: Wadsworth.

[30] Keil, M., Beranek, P. M., & Konsynski, B. R. (1995). Usefulness and ease of use: Field study evidence regarding task considerations. *Decision Support Systems, 13,* 75-91.

[31] Kozma, R. B., & Croninger, R. G. (1992). Technology and the fate of at-risk students. *Education and Urban Society, 24,* 440-453.

[32] Larson, Ray R. (1994). *Design and development of a network-based electronic library.*(http://sherlock.berkeley.edu/diglib/asis.html). (ray@sherlock.berkeley.edu).

[33] Lesk (1997). In Rama Nand Malviya (2008). Digital Library & Academic Society in India (1st ed.). New Delhi, Asian Books Ptiuate Limited, pp. 2-3.

[34] Levy, D. M., & Marshall, C. C. (1995). Going digital: a look at assumptions underlying digital libraries. *Communications of the ACM,* 38 (4), 77-84.

[35] Lynch, Clifford and Garcia-Hector. (1995). (Eds.) Inter-operability, scaling and the digital libraries research agenda. A report on the May 18-19 1995 IITA Digital Libraries Workshop. (Clifford.lynch@ucop.edu) , (hector@db.standford.edu) (http://www.diglib.standford.edu/diglib/pub/reports/iitadlw/main.html).

[36] Means, B., Ed. (1994). *Technology and education reform.* San Francisco, CA: Jossey-Bass.

[37] Microsoft (2003). Microsoft's case study on IVLE. Retrieved October 2, 2003, from Microsoft's in Education on the World Wide Web: http://www.bpghs.wizlearn.net/public/case-study.html.

[38] Nielsen, J. (1993). Usability Engineering. San Diego, CA: Academic Press.

[39] Popkiewicz, T. S. (2000). The denial of change in educational change: Systems of ideas in the construction of national policy and evaluation. *Educational researcher,* 29(1), 17-29.

[40] Rama Nand Malviya (2008). Digital Library & Academic Society in India: Features of digital libraries. Kamal Jagasia for Asian Books Pvt. Ltd. New Delhi.

[41] Sarason, S. B. (1971). *The culture of the school and the problem of change*. Boston: Allyn and Bacon, Inc.

[42] Scott Steven, DEAN Zollman, Michal Christel, Brian Adrian (2007). Virtual Pedagogical Agents as Aids for High School Physics Teachers. ICL Conference, September 26-28, 2007 Villach, Austria.

[43] Snoeyink, R., & Ertmer, P. G. (2001-2002). Thrust into technology: How veteran teachers respond. *Journal of Educational Technology Systems*, 30(1), 85-111.

[44] Snyder, I. (1998). Beyond the hype: reassessing hypertext. In I. Snyder (Ed.), Page to screen: Taking literacy in the electronic era. London/New York: Routledge.

[45] Teal Anderson and Sayeed Choudhury (2008). A Usability Research Agenda for Digital Libraries (Baltimore, Maryland: The Digital Knowledge Center Sheridan Libraries, John Hopkins University. http://dkc.jhu.edu/~teal/usability_research_agenda.html. 13 August 2008).

[46] Technology Based Learning & Research (1998). *Mathedology* on CD-ROM. Tempe, AZ: Arizona State University.

[47] Timothy E. Morse (2004). Ensuring equality of educational opportunity in the digital age. *Education and Urban Society, 36*(3), 266-279.

[49] UNECA. (2003). Digital libraries and virtual libraries: Definitions, Concepts, and Goals. Workshop on Technical Aspects of Building Digital Libraries and Electronic Information Networks. L/ECA/DISD/AVLIN/9.

[50] Vergara, M. N. Capuano & E. Sangineto (2003). Diogene: a Training Web Broker for ITC Professionals, in 2nd Int. Conference on Multimedia and ICT in Education (m-ICTE 2003) Badajoz, Spain, 330-4.

[51] Vrasidas, C., McIsaac, M. (2001). Integrating technology in teaching and teacher education: Implications for policy and curriculum reform. *Educational Media International, 38*(2/3), 127-132.

[52] Waters (1992). In Rama Nand Malviya (2008). Digital Library & Academic Society in India (1st ed.). New Delhi, Asian Books Ptiuate Limited, pp. 2-3.

[53] Wiburg, K. M. (1997). The dance of change: Integrating technology into classrooms. *Computers in the Schools*, 13, 171-184.

[54] Witten, I. H., & Bainbridge, D. (2002). How to build a digital library. San Francisco: Morgan Kaufmann.

[55] Wu, S. and Witten, I. H. (2006). Towards a digital library for language learning. *Proc European Conf. on Digital Libraries*. Pp. 341-352, Alicante. Spain.

[56] Xie, H. I. (2008). Users' evaluation of digital libraries (DLs): Their uses, ---, *Information Processing and Management* (2008), doi:10.1016/j.imp.2007.10.003.

BIBLIOGRAPHY

Abbas, J., Norris, C. and Soloway, E. (2002). Middle school children's use of ARTE-MIS Digital Library. *In ACM/IEEE Joint Conference on Digital Libraries (JCDL'02)*, (Portland, Oregon (July 14-18),2002), ACM Press, 98-105.

Adachi, J. (2000). NACSIS-ELS: Digital library of Tapanese academic journals. *In Proceedings of the 3rd International Conference on Asian Digital Library.* (pp. 15-22). Seoul, Korea.

Adams, A., & Blandford, A. (2002). Digital libraries in academia: Challenges and changing. *In Proceedings of the Fifth International Conference on Asian Digital Libraries* (ICADL 2000) (pp. 392-403).

Adams, A., Blandford, A., Budd, D., & Bailey, N. (2005). Organisational communication and awareness: A novel solution. *Health Informatics Journal, 11*, 163-178.

Adams, D. A., Nelson, R. R., & Todd, P. A. (1992). Perceived usefulness, ease of use, and usage of information technology: A replication. *MIS Quartely, 16(2)*, 227-247.

Adler, A., Gujar, A., Harrison, B. L., O'Hara, K., & Sellen A. (1998). A diary study of work-related reading: design implications for digital reading devices. *In Proceedings of HCI'*98, pp. 241-248.

Agarwal, R., & Day, A. E. (1998). The impact of Internet on economic education. *Journal of Economic Education, 29*, 99-110.

Agosti, M., Crestani, F. (1993). A methodology for the automatic costruction of a hypertext for information retrieval. *In: Proceedings of the ACM Symposium on Applied Computing*, pp. 745-753. Indianapolis, USA.

Agosti, M., Crestani, Fi Gradenigo, G., Maltiello, P. (1989). The hypertext as an effective information retrieval tool for the final user. In A. A. Martino (ed.) *Preproceedings of the 3rd International Conference on Logics, Informatics and Law*, Vol. 1, pp. 1-19.

Agosti, M., Crestani, Fi Gradenigo, G., Maltiello, P. (1990). An approach for the conceptual modeling of IR auxiliary data. *In 9th Annual IEEE International Conference on Computers and Communications*, pp. 500-505. Scottsdale, Arizona.

Ahlberg, C., Williamson, C., and Shneiderman, B. (1994). Dynamic queries for information exploration: An implementation and evaluation. In the sparks of innovation in human-computer interaction, B. Shneiderman, Ed. Ablex, Norwood, N. J., pp. 281-294.

Ahmed, Faisal (2004). Generating conceptually personalized interactions for educational digital libraries using concept maps. Thesis, UMI No. 3337215.

Alexander, P. A., & Knight, S. L. (1993). Dimensions of the interplay between learning and teaching. *Educational Forum, 57*, 232-245.

Altman H. B. and James C. V. (Eds.) (1980). *Foreign Language Teaching: Meeting Individual Needs*, Oxford: Pergamon Press.

Anderson JR. (2000). *Cognitive Psychology and its Implications*. 5th ed. USA: Worth Publishers.

Andy Dong and Alice M. Agogino (2001). Design principles for the information architecture of a SMET Education Digital Library *In IEEE/ACM Joint Conference on Digital Libraries.* Roanoke, VA, USA. Available at URL: www.engineeringpathway.com/smete/public/about_smete/publications /JCDL-0601/dongagoginojcdl01-01.pdf.

Ann Blandford, Ann Adams, Simon Attfield, George Buchanan, JeremyGow, Stephann Markri, Jon Rimmer, and Claire Warwick (2007). The PRET A Rapporter framework: Evaluating digital libraries from the perspective of information work. *Information Processing and management 44* (2008) 4-21, doi: 10.1016/j.imp.2007.01.021.

Antani, S., Kasturi, R. and Jain, R. (2002). A survey on the use of pattern recognition methods for abstraction, indexing and retrieval of images and video, *Pattern Recognition 35 (4)*: 945-965.

Arms, W. Y., Blanchi, C. & Overly E. A. (1997). An Architecture for Information in Digital Libraries. *D-Lib Magazine*.

Arpit Jan (2008). Intinno: A Web integrated digital library and content management system. Thesis. Indian Institute of Technology Kharagpur. April 2008.

Askin, A. Y. (1998). Effectiveness of usability evaluation methods at a function of users' learning stages. Master's thesis, Purdue University.

Atilgan, D., & Bayram, O. (2006). An evaluation Turkey. *Journal of Academic Librarianship, 32,* 86-93.

B. P. Prakash. (1996). Digital imaging: Technology, *trends and impact on libraries, SIS-96,* 18-20, Jan. '96, Bangalore.

Baddeley AD. (1992). Working memory. Science. 225: 556-9.

Bagozzi, R. P. (1981). Evaluating structural equation models with unobservable variables and measurement error: A comment. *Journal of Marketing Research, 18(3)*, 375-381.

Bagozzi, R. P. (1982). A field investigation of causal relations among cognitions, affect, intentions, and behavior. *Journal of Marketing Research, 19(4)*, 562-583.

Barbara Cockrell & Elaine Anderson Jayne (2002). How do I find an article? Insights from a Web usability study. *The Journal of Academic Librarianship* 28(3) (2002, May): 122-132.

Barnes, S. (2000). What does electronic conferencing afford distance education? *Distance Education 21,* 236-247.

Barron, L. C., & Goldman, E. S. (1994). Integrating technology with teacher preparation. In B. Means (Ed.), *Technology and Education Reform* (pp. 57-81). San Francisco, CA: Jossey-Bass.

Barry, C. A. (1997). The research activity timeline: A qualitative tool for information research. *Library & Information Science Research, 19(2),* 253-179.

Bates, M. (1990). Where should the person stop and the information search interface start? *Information Management, 26 (5)*, 575-591.

Becker, H. J., & Ravitz, J. L. (2001). *Computer use by teachers: Are Cuban's predictions correct?* Paper presented at the American Educational Research Association, Seattle, WA.

Becker, H. J., & Riel, M. M. (2000). Teacher professional engagement and constructive-compatible computer usage. *Teaching, Learning, and Computing*. Retrieved February 28, 2009, from http://www.crito.uci.edu/tlc/findings/report_7/

Beeman, W. O. et al, (1987). Intermedia – a case study of innovation in higher education, providence, RI. Brown University.

Bereiter, C., & Scardamalia, M. (1987). The psychology of written composition. Hillsdale, NJ:L. Erlbaum.

Bickel, B., & Truscello, D. (1996). New opportunities for learning: Styles and strategies for computers. *TESOL Journal, 6(1)*, 15-19.

Bishop, A. P. (1998). Digital libraries and knowledge disaggregation: the use of Journal Article Components. *In Proceedings of ACM DL*'98, pp. 29-39.

Bishop, A. P. (1999). Making digital libraries go: comparing use across genres. *In Proceedings of ACMDL*'99 pp. 94-103.

Blandford, A., & Buchanan, G. (2002). Workshop report: Usability of Digital Libraries @ JCDL'02. SIGIR Forum, 36 (2), 83-89.

Blandford, A., & Buchanan, G. (2003). *Usability of digital libraries: A source of creative tensions with technical developments.* TCDL Bulletin. Retrieval April 12, 2009 from: http://www.ieee.tcdl.org/Bulletin/v1n1/blandford/blandford.html.

Blandford, Ann, et al. (2004). Analytical usability evaluation for digital libraries: A case study. *Proceedings of the fourth ACM/IEEE Joint Conference on Digital Libraries*, New York: ACM Press, 27-86.

Borgman, C. L. (1996). Social aspects of digital libraries. In: E. A. Fox & G. Marchionini (Eds.), *Proceedings of the 1st ACM International Conference on Digital Libraries* pp. (170-171). Bethesda, MD.

Borgman, C. L., Leazer, G. H., Gilliland-Swetland, A. J. & Gazan, R. (2000). Evaluating digital libraries for teaching and learning in undergraduate education: A case study of the Alexandria digital earth prototype (ADEPT). *Library Trends, 49(2)*, 228-250.

Brockman, W. S., Neumann, L., Palmer, C. L., Tidline, T. J. (2001). Scholarly work in the humanities and the evolving information environment. Digital library federation and council on library and information resources (CLIR), Washington, DC.

Brooks, B. C. (1968). The derivation and application of the Bradford_zipfDistribution. *Journal of Documentation*. 24, 247-265.

Brown, J. S., Collins, A., Duguid, P. (1998). Situated cognition and the culture of learning. *Educational Researcher, 18*, 32-42.

Brown, M. R. (2000). Access, instruction, and barriers: Technology issues facing students at risk. *Remedial and Special Education, 21*, 182-192.

Brown, T. A. (2006). *Confirmatory Factor Analysis for Applied Research.* New York: The Guilford Press.

Bruce, B., Peyton, J. K., & Baston, T. (Eds.). (1993). *Network-based classrooms: Promises and realities.* Cambridge, England: Cambridge University Press.

Bryne, B. M. (2001). Structural equation modeling with AMOS: Basic concepts, application, and programming. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Buchanan, G., & Hinze, A. (2005). A generic alerting service for digital libraries. *In: Proceedings of the joint conference on digital libraries* (pp. 131–140). Denver, Colorado, June 7–11.

Busstra, M. C. (2008). Design and evaluation of digital learning material for academic education in Human Nutrition. Thesis Wageningen University, The Netherlands, 2008 – with summary in Dutch. 841-1.

Byran-Kinns, N., Blanford, A., & A thimbleby, H. (2000). Interaction modeling for digital libraries. In Workshop on Evaluation of Information Management System. Landon, UK.

Byrne, A. (2003). Digital libraries: Barriers or gateways to scholarly information? *The Electronic Library*, 21 (5), 414-421.

Card, S., Moran, T. and Newell, A. (1983). The psychology of human-computer interaction. Hillsdale NJ: Lawrence Erlbaum Associates.

Carico, K. M., & Logan, D. (2004). A generation in cyberspace: engaging readers through online discussions. *Language Arts, 81*, 293-302.

Carmines, E., & MacIver, J. (1981). Analyzing models with unobserved variables: Analysis of covariance structure. In G. Bohmstedt, & E. Borgatta (Eds.), *Social Measurement: Current Issues*. Beverly Hills, California: Sage.

Carr, L., Miles-Board, T., Wills, G., Power, G., Bailey, C., Hall, W., et al. (2004). Extending the role of the digital library: computer support for creating articles. *In Proceedings of the 15th conference on hypertext and hypermedia* (pp. 12-21). New York, YN: ACM Press.

Carroll, J. (2000). Making use: Scenario based design of human-computer interactions. Cambridge, MA: MIT Press.

Carter, D. S., & Janes, J. (2000). Unobtrusive data analysis of digital reference questions and service at the Internet Public Library: An exploratory study. *Library Trends, 49*, 251-265.

Castells, Manuel (2003). Licoes da Internet. In: MORAES, Denis de. (org). Por uma Outra Comunicacao: media, mundializacao, cultura e poder. Rio de Janeiro: Record.

Chan, C. H., Sun, A., & Lim, E. P. (2001). Automated online news classification with personalization. *In Proceedings of the 4th International Conference on Asian Digital Library Workshop.* (pp. 320-329). Bangalore, India.

Chapelle, C. A. (2001). *Computer-applications in second language acquisition: Foundations for teaching, testing and research.* New York: Cambridge University Press.

Chen, H. (2003a). *Towards building digital library as an institution of knowledge.* Paper presented at wave of the Future: NSF Post Digital Libraries Futures Workshop, June 15-17, Chathman, Massachusetts. Retrieved from the World Wide Web: http://www.sis.pitt.edu/%7Edlwkshop/paper-chen.html

Chen, N. (2006). A survey of indexing and retrieval of multimodal documents: text and image, technical report, 2006-505, Queen's University.

Chen, S. C. (1996). The spread of English in Taiwan: A social linguistic study. *Proceedings of the 13th Conference on English Teaching and Learning in Republic of China,* 321-330.

Chen, Z., Liu, W. Y., Zhang, F., Li, M. J. and Zhang (2001). Web mining for web image retrieval. *Journal of American Society for Information Science and Technology, 52 (10)*: 831-839, 2001.

Cheng, Y. C. (1999). *BBS as a virtual EFL Learning community: Research and implications.* Retrieved August 1, 2009, from http://mavis@mradio.url.com.tw.

ChengFu Chou. (2002). Scalable design of wide-area upload applications and distributed continuous media systems, Dissertation, UMI No. 3055558.

Cherry, J. M. & Duff, W. M. (2002). Studding digital library users over time: A follow-up survey of early Canadiana online. Information Research, 7(2), Retrieval March 12, 2009, from http://informationr.net/ir/7-2/paper123.html.

Chiu, C. M. (1997). Fusing the World Wide Web and open hypermedia system technologies (Doctoral dissertation, Rutgers University, 1997). *ProQuest Dissertation Abstracts*, AAC.

Choo, C. W., Detlor, B., & Thurnbull, D. (2000). Information seeking on the web: An integrated model of browsing and searching. First Monday, 5 (2).

Clark, C., & Gorski, P. (2001). Multicultural education and the digital divide: Focus on race, language, socioeconomic class, sex, and disability. *Multicultural Perspectives, 3*(3), 39-44.

Claudia Roda, Ann M. Borel et al. (2005). Digital image library development in academic environment: designing and testing usability. *OCLC Systems & Services 21 (4)* (2005): 264-284.

Cole, C. (1999). Activity of understanding problem during interaction with an "enabling" information retrieval system: Modeling information flow. *Journal of American Society for information Science*, 50 (6), 544-552.

Coleman, A., Smith, T., Buchel, O., & Mayer, R. (2001). Learning spaces in digital libraries. In P. Constantopoules & I. T. Sølvberg (Eds.), Research and Advanced Technology for Digital Libraries, ECDL 2001: Lecture Notes in Computer Science 2163 (pp. 251-262). Berlin: Springer-Verlag.

Collins, A. (1991). The role of computer technology in restructuring schools. *Phi Delta Kappan, 73*, 28-36.

Collins, L. M., Mane, K. K., Martinez, M. L. B., Hussell, J. A. T., & Luce, R. E. (2005). ScienceSifter: Facilitating activity awareness in collaborative research groups through focused information feeds. *In First international conference on e-Science and grid computing* (pp. 40–47). Melbourne, Australia: IEEE Computer Society, December 5–8.

Conzett. J. (2000). Integrating collocation into a reading and writing course. In teaching Collocation. Edited by Lewis Michael, pp. 70-87. LTP, England.

Cory Marchionini and Hermann Maurer (1995). The role of digital libraries in teaching and learning. *Communication of the ACM, April 1995/vol. 38*, No.4.

Costabile, M. F., Esposito, F., Semeraro, G., & Fanizzi, N. (1999). An adaptive visual environment for digital libraries. *International Journal on Digital Libraries, 2*, 124-143.

Covi, L. & Kling, R. (1997). Organizational dimensions of effective digital library use: Closed rational and open natural systems model. In Kiesler, S. Culture of the Internet, Lawrence Erlbaum Associates, New Jersey, pp. 343-360.

Cox, I. J., Miller, M. L., Minka, T. P., and Papsthomas, T. V. (2000). The Bayesian image retrieval system, PicHunter: theory, implementation, and psychophysical experience. IEEE Trans. *Image Processing*, Vol. 9, No. 1, pp. 20-37.

Cox, I. J., Miller, M. L., Omohundro, S. M. and Yianilos, P. N. (1996). Target testing and the PicHunter Bayesian multimedia retrieval system, *Proceedings of 3rd of Forum on Research and Technology Advances in Digital Libraries* (ADL96), Washington DC, USA, pp. 66-75.

Cradler, J., & Cradler, R. (1995). *Prior studies for technology insertion.* San Francisco: Far Web Laboratory.

Crane, G. (1994). *Perseus 2.0 Yale University Press*. New Haven Ct.

Crestani Fabio. From linking text to linking crimes: Information retrieval, but not as you know it. In Croft W. B. (2008). *Information Access Through Search Engines and Digital Libraries* (Eds.), Springer.

Cuban, L. (1986). *Teachers and machines: The classroom uses of technology since 1920*. New York: Teachers College Press.

Cuban, L., & Kirkpatrick, H. (1998). Computers make kids smarter-right? *Techos, 7*(2), 1-6.

Cunningham, S. J., & Mahoui, M. (2000). Search behavior in two digital libraries:A comparative transaction log analysis. *In Proceedings of the 3rd International Conference on Asian Digital Library*. (pp. 193-200), Seoul, Korea.

Daging He, Ming Mao, Yefei Peng. *DiLight: a digital library based e-learning environment for learning digital libraries*. Available at the URL: www.sis.pitt.edu/~daqing/docs/dilightelearnfinal.pdf

Dagobert Soergel (2008). *Digital libraries and knowledge organization.* Retrieved May 29, 2009, from the World Wide Web: www.dsoergel.com/newPublications/SoergelDigitalLibrariesandKnoledgeOrganization.pdf.

Davis, F. D. (1989a). Perceived usefulness, perceived ease of use, and acceptance of information technology. *MIS Quarterly, 13(3)*, 319-340.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989b). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35(8)*, 982-1003.

Dee, C. & Stanley, E. E. (2005). Information-seeking of nursing students and clinical nurses: Implications for health sciences library. *Journal of Medical Library Association*, 93(2).

Deewester, S., Dumais, S. T., Furnas, G. W., Landaure, T. K., & Harshman, R. (1990). Indexing by latent semantic analysis. *Journal of the American Society for Information Science, 41 (6)*, 391-407.

Del Bimbo A. (1999). *Visual Information Retrieval*, Morgan Kaufmann Publishers, San Francisco, Calif.

Delia Neuman (1997). Learning and the digital library. *Library Trends, Vol. 45*, No. 4, Spring 1997, pp. 687-707.

Dervin, Brenda; Nilan, Michael (1986). Information needs and uses. *ARIST, Vol. 21*, pp. 3-33.

Deutsch, P. (1992). Resource discovery in an Internet environment – The Archie approach. Electronic. Networking: *Res.Appl. Policy 1,2*, 45-51.

Di Sessa, A. A. (1988). What will it mean to be educated in 2020? In: R. S. Nickerson and P.P. Zodhiates, (editors), Technology in Education: Looking Toward 2020. Hillsdale, N. J.: Erlbaum, pp. 43-66.

Dicheva, D. & C. Dichev (2004). A framework for Concept-based digital course libraries. *Journal of Interactive Learning Research, 15 (4)*. 347-64.

Dickensen L. (1987). *Self-instruction in Language Learning*, Cambridge University Press.

Diederen J., Gruppen H., Hartog R, Voragen GJ. (2006). Design and evaluationof digital assignments on research experiments within food chemistry. *Journal of Science Education and Technology. 15*: 227-46.

Dillon, A. (1999). Evaluating on TIME: A framework for the expert evaluation of digital library interface usability. *International Journal on Digital Libraries. 2 (2/3)*, 170-177.

Dillon, A., & Gabbard, R. (1998). Hypermedia as an educational technology: A review of the quantitative research literature on learner comprehensive, control and style. Review on Educational Research, 68(3), 322-349.

Donghua Tao (2008). Using theory of reasoned action (TRA) in understanding selection and use of information resources: An Information resource selection and use model. PhD. Dissertation, Faculty of the Graduate School, University of Missouri, Columbia.

Dorward, J., Reinke, D., & Recker, M. (2002). An evaluation model for a digital library. *In Proceedings of Joint Conference of Digital Libraries* (pp. 322-323). New York: ACM.

Doyle, L. B. (1975). Information retrieval and processing. Melville, Los Angeles.

Druin, A., Bederson, B., & Hourcade, J. P. (2003). Designing a digital library for young children: An intergenerational partnership. In E. Fox, & C. Borgman (Eds.), *Proceedings of ACM/IEEE Joint Conference on Digital Libraries* (pp. 398-405). Roanoke, VA: ACM Press.

DUCA Tran. (1996). Overlay multicast solutions to media streaming, dissertation, B.S. Vitnam National University, Hanoi, Vietnam UMI.

Dueme, L., Fontenot D., Gumfory K., Kallus M., Larsen J., Schafer., et al. (2002). The use of online synchronous discussion groups to enhance community formation and professional identity development. *Journal of Interactive Online Learning 1*, Retrieved April 9, 2009, from http://www.ncolr.org/jiol/ARCHIVES/2002/2/04/

Dunn, R. (1983). Learning style and its relation to exceptionality at both ends of the spectrum. *Exceptional Children*, 49, 496-506.

Dunn, R. (1984). Teaching students through their perceptual strength or preferences. *Journal of Reading, 31*, 304-309.

Eakins John, P. (2002). Towards Intelligent image retrieval, Pattern Recognition 35; 3-14.

Edward A. Fox. Overview of Digital Library Component and Development. USA.

Egan, D., Remde, J., Gomez, L., Landauer, T., Eberhardt, J., Lochbaum, C. (1989). Formative design – evaluation of superbook. *ACM Transactions on Information Systems 7 (1)*, 30-57.

Elahe Zani-Sabihi, Gheorghita Ghinea, & Sherry Y. Chen (2006). Digital libraries: what dousers want? *Online Information Review 30 (4)* (2006): 395-412.

Elaina Norlin & CM! Winters (2001). Usability testing for libraries (Chicago, Illinois: American Library Association, 2001), p. 125.

Ellis G. and Sinclair B. (1987). *Training for Learners of English* (Pilot Edition), Cambridge University Press.

Ellis, D. (1993). Acomarison of the information seeking patterns of researchers in the physieal and social sciences. *Journal of documentation*, 49 (4), 356-369.

Ellis, Davis (1990). New Horizons in information retrieval. Association publishing house ltd.

Els Kuiper, Monique Volman, and Jan Terwel (2005). The Web as Information Resorsce in K-12 Education: Strategies for Supporting Students in searching and processing. *Review of Educational Research Fall 2005, Vol. 75*, No. 3, pp. 285-328.

Emig, J. (1977). Writing as a model of learning. *College Composition and Communication*, 28 (2), 122-128.

Enrique Frias-Martinez, Sherry Y. Chen_, Xiaohui Liu (2008) Investigation of behavior and perception of digital library users: A cognitive style perspective. *International Journal of Information Management* 28 (2008) 355–365.

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration. *ETR&D-Educational Technology Research and Development, 53*(4), 25-39.

Fairthone, R. A. (1961). The Mathematics of classification towards information retrieval. London: Butter worth's. 1-10.

Faloutsos, C., Barber, R., Flickner, M., Hanfner, J., Niblack, W., Petkovic, D. and Equitz, W. (1994). Efficient and effective querying by image content. *Journal of Intelligent Information System 3 (34)*: 231-262.

Farrington, G. (1994). Penn's plans for integrating emerging technologies. *The Technological Horizons in Educational Journal, 22 (3)*, 104-106.

Fidel, R. K., Douglass, M. H., Holder, J. K., Hopkins, C. J., Kushner, E. J., et al. (1999). A visit to information mall: Web searching behavior of high school students. *Journal of American Society for information Science, 50 (1)*, 24-37.

Fine, S. (1984). Research and the psychology of information use. *Library Trends, 32 (4)*, 445-446.

Fister, B. (1992). The research processes of undergraduate students. *Journal of Academic Librarianship*, 18(3), 163-169.

Fitzgerald, M. (1998). *Information, Knowledge and Learning: The Library in the Digital Age*. Report prepared for the Marc Fresko Consultancy. http://ukoln.ac.uk/services/papers/bl/blri078/content/repor~20.htm

Fleming, M., & Levie, W. H. (1978). Instructional message design: Principles from the behavior sciences. Englewood Cliffs, NJ: Educational Technology Publications.

Fleming, M., & Levie, W. H. (Eds.) (1993). International message design: Principles from the behavioral and cognitive sciences (2d ed.). Englewood Cliffs, NJ: Educational Technology Publications.

Florini, B. M. (1989). Teaching Styles and Technology. *New Directions for Continuing Education, 43*, 41-53.

Ford, N. (2003). Modeling cognitive processes in information seeking: From popper to pask. *Journal of American Society for information Science*, 55 (9), 769-782.

Fox, E. A., Akscyn, R. M., Furuta, P. K. and Leggett, J. J. (1995). Digital libraries communications of the ACM, 38 (4), 22-28.

Frias-Martinze, E., Magoulas, G., Chen, S. & Macredie, R. (2006). Automated user modeling for personalized digital libraries. *International Journal of Information Management*, 26 (3), 234-248.

Frizler, K. (1995). The Internet as an educational tool in ESOL writing instruction. Master's thesis, San Francisco State University, San Francisco, CA.

Fuentes, C. A. (2003). The use of corpora and IT in a comparative evaluation approach to oral business English. *RecCALL, 15(2)*. PP. 189-201.

Fuhr, N. (1992). Probabilistic models in information retrieval. *The Computer*

Journal, 35 (3), 243-255.

Fuhr, N., Klas, C.-P., Schaefer, A., & Mutschke, P. (2002). Daffodil: An integrated desktop for supporting high-level search activities in federated digital libraries. *In Research and advanced technology for digital libraries. 6th European Conference ECDI* pp. 597-612. Rome, Italy: Springer.

Fullan, M. (1993). *Change forces: Probing the depths of educational reform.* Bristol, PA: The Falmer Press, Taylor & Francis Inc.

Fullan, M., & Stiegelbauer (1991). *The new meaning of educational change* (2nd ed.). New York, NY: Teachers Chollege, Columbia University.

Furnas, G. W., & Rouch, S. J. (1998). Considerations for information environments and the NaviQue workspace. *Proceedings of ACM DL'98*, pp. 79-88.

Furtado, Elizabeth, Joao Jose Vasco Furtado, Feranando Lincoln Maths, and Jean Vanderdonckt (2003). Improving usability of online learning system by means of multimedia, collaboration and adaptation resources. In Usability evaluation of online learning programs, ed. Claude Ghaoui, 69-86. Hershey, PA: Information Science Publishing.

Garrison, D. R. (2003). Cognitive presence for effective asynchronous online learning: The role of reflective inquiry, self-direction and metacognition. In J. Bourne & J.C.

Geddes M. and Sturtridge G. (1982). *Individualization*, London: Modern English Publications.

Giles, C. L., Bollacker, K., & Lawrence, S. (1998). CiteSeer: An automatic citation indexing system. *Proceedings of the International Conference on Digital Libraries*, (pp. 89-98).

Goodrum, D. A.; Dorsey, T.; & Schwen, T. M. (1993). Defining and building an enriched learning and information environment. *Educational Technology, 33 (11)*, 10-20.

Gopen D. Key (1993). In Rama Nand Malviya (2008). Digital Library & Academic Society in India (1st ed.). New Delhi, Asian Books Ptiuate Limited, pp. 2-3.

Gorski, P. C. (2002). Dismantling the digital divide: A multicultural education framework. *Multicultural Education, 10*(1), 28-30.

Gould, J. D., Alfaro, L., Bames, V., Finn, R., Grischkowsky, N. and Minuto, A. (1987). Reading is slower from CRT displays than from paper: attempts to isolate a single variable explanation. *Human Factors, 29 (3)* 269-299.

Graff, M. (2005). Individual differences in hypertext browsing strategies. *Behaviour and Information Technology, 24(2)*, 93–99.

Graham, M. & Scarborough, H. (1999). Computer mediated communication and collaborative learning in undergraduate distance education environment. *Australian Journal of Education Technology, 15(1)*, 20-46.

Green, L. (1998). *Online conferencing: Lessons learned. Office of Learning Technologies, Government of Canada.* Retrieved April 9, 2009, from http://emoderators.com/moderators/lessonse.pdf.

Greenburger, M. (1995). East meets west: A multicultural look at multimedia. *Education review, 30 (1),* 25-30.

Gregorc, A. F., & Ward, H. B. (1977). A new definition for individual. NASSP Bulletin.

Groeling, T. (1999). Virtual discussion - Web-Based discussion forums in political science. Paper presented at *the annual meeting of the American Political Science Association.* Retrieved April 8, 2009, from http://pro.harvard.edu/abstracts/009/009001GroelingTi.html.

Gutwin, C., Paynter, G. Witten, I., Nevill – Manning, C., & Frank, E. (1999). Improving browsing in digital libraries with keypharse indexes. *Journal of Decision Support Systems, 27 (1-2),* 81-104.

Hamblin, Y., & Stubbings, R. (2003). *The implementation of Metalib and SFX at Looghborough University Library: A case study.* Retrieved March 8, 2009, from the World Wide Web: www.jisc.ac.uk/uploaded_documents/Metalibcasestudy.pdf

Hannafin, M. J. (1992). Emerging technologies, ISD, and learning environments: Critical perspectives. *Educational Technology Research Development*, 40 (1), 49-63.

Hannafin, M. J.; Hall, C.; Land, S.; & Hill, J. (1994). Learning in open-ended environments: Assumptions, methods, and implications. *Educational Technology, 34 (10),* 48-55.

Hansen, P., & Ja¨rvelin, K. (2005). Collaborative information retrieval in an information-sensitive domain. *Information Processing and Management, 41,* 1101–1119.

Haralick, R. M. (1979). Statistical and structural approaches texture, *Proceedings of the IEEE,* Vol. 67 (5), pp. 786-804.

Harasim, L., Hiltz, S. R., Teles, L., & Turoff, M. (1995). *Learning networks: A field guide to teaching and learning online.* Cambridge, MA: MIT Press.

Hazari, S. (2004). Strategy for assessment of online course discussions. *Journal of Information Systems Education, 15,* 349-355.

Heb, M., & Drobink, O. (1999). Clustering specialized Web-databases by exploiting hyperlinks. *In Proceedings af the 2nd International Conference on Asian Digital Library Workshop.* (pp. 10-29). Taipei, Taiwan.

Hewagamage, K. P., C. Jayawardana and M. Hirakawa (2001). Shallow copying of multimedia sources for virtual documents. *Proceedings of IEEE International Conference of Multimedia & Expo.* August. Forthcoming.

Hill, L. L., Carver, L., Larsgaard, M., Dolin, R., Smith, T. R., Frew, J. et al. (2000). Alexandria digital library: User evaluation studies and system design. *Journal of the American Society for Information Science, 51,* 246-259.

Hinze, A., Buchanan, G., Jung, D., & Adam, Anne. (2006). HDLalert – A healthcare DL alerting system: From user needs to implementation. *Health Informatics Journal, 12(2)*, 121–135.

Hirsh, S. G. (1997). How do children find information on different types of tasks? Children's use of science library catalog. *Library Trends, 45 (4)*.

Ho, C. H., & Swan, K. (2007). Evaluating online conversation in an asynchronous learning environment: An application of Grice's cooperative principle. *Internet and Higher Education, 10,* 3-14.

Honebein PC. Duffy T M., Fishman BJ. (1993). Constructivism and the design of learning environments: context and authentic activities for learning. In: Duff TM., Lowyck J, Jonassen DH, editors. Designing environments for constructivism learning. Berlin: Springer-Verlag, pp. 87-108.

Horea Todoran (2002). *The road to real multimedia database emerging multimedia data types*. STUDIA UNIV. BABES-BOLYAI, INFORMATICA, Volume XLVII, Number 2.

Horton, W. (2001). *Evaluating e-Learning*. Alexandria, VA: ASTD.

Hsinchun Chen, Yilu Zhou. (2005). Survey and History of Digital Library Development in the Asia Pacific. Design and Usability of Digital libraries (pp.2). INFOSCI.

Hu, L. & Bentler, P. M. (1999). Cutoff criteria for indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1-55.

Hu, Y., Li, H., Cao, Y., Meyerzon, D., & Zheng, Q. (2005). Automatic extraction of titles from general documents using machine learning. *Proceedings of the Joint Conference on Digital Libraries*, (pp. 145-154).

Hwang, W. Y., Wang, C. Y., Sharples, M. (2007). A study of multimedia annotation of Web-based materials. *Computers and Education 48 (4)*, 680-699.

Ian Rowlands & David Bawden (1999). Digital libraries: *A conceptual Framework. Libr., vol 49*, pp. 192-202.

IBM. (1994). *Digital libraries: gross structure and requirement creport from the workshop*. [Online] available (Accessd 9 July 2009) www: http://www.ifla.org/documents/libraries/net/rj9840.pdf.

Igbaria, M., Guimaraes, T., & Davis, G. B. (1995). Testing the determinants of microcomputer usage via a Structural Equation Model. *Journal of Management Information Systems, 11(4)*, 87-114.

Im, Y., & Lee, O. (2004). Pedagogical implications of online discussion for preservice teacher training. *Journal of Research on Technology in Education, 36,* 155-170.

Ingwersen, P. (1992). Information retrieval interaction. Taylor Graham, London.

Ismail Fahmi (2003). Development of Indonesia's National Digital Library Network, *In Design and Usability of Digital Libraries (2005)*. (pp. 38-

54).

ISO/IEC JTC1/SC29/WG11/W3703 MPEG-7 (2000). Multimedia content description interface part3 visual.

Jaime A. and Chang, S. F. (2000). A conceptual framework for indexing visual information at multiple levels, IS ␣ T/SPIE *Internet Imaging Vol. 3964*, San Jose, CA January,2000.

Janee, G. and Frew, J. (2002). The ADEPT Digital Library Architecture. *In ACM/IEEE Joint Conference on Digital Libraries* (JCDL'02), (Portland, Oregon (July 14-18), 2009) ACM Press, 342-349.

Jarvelin, K., & Ingwersen, P. (2004). Information seeking research needs extension towards tasks and technology. *Information Research, 10* (1).

Jayawardana C., K. P. Hewagamage and M. Hirakawa. (2000). Virtual authoring based on the sallow copy technique for a collection of digital documents. *In Proceedings International Symposium on Multimedia Software Engineering*. Los Alamitos: The IEEE Computer Society.

Jayawardana C., K. P. Hewagamage and M. Hirakawa. (2001). Database Systems Lab, Graduate School of Information Engineering, Hiroshima University. *MC Journal of Academic Media Librarianship*, v.8#1, summer 2001.

Jeng, J. (2005a). Usability assessment of academic digital libraries: Effectiveness, Efficiency, Satisfaction, and Learnability. *LIBRI, 55(2-3)*, 96-121.

Jeng, J. (2005b). What is usability in the context of digital library and how can it be measured? *Information Technology and Libraries 24(2)*, 47-56.

Jennifer Ward & Steve Hill (2005). Usability testing: Interface design, and portals. *Journal of Library Administration 43 (1/2)* (2005): 155-171.

Joe, S. G., & You, Y. L. (2001). *Investigating the metacognitive awareness and strategies of English-majored university student writers*. In Selected papers from the Tenth International Symposium on English teaching, Taiwan, ROC (pp. 106-119).

Jonassen, D. (1996). Computers in the Classroom: Mindtools for Critical thinking, Englewood Cliffs, N. J.: Merrill.

Jonassen, D. H., Peck, K. L., & Wilson, B. G. (1999). *Learning with technology: A constructivist perspective*. Upper Saddle River, NJ: Prentice-Hall.

Jones, S., & Mahoui, M. (2000). Hierarchical document clustering using automatically extracted key phrases. *In Proceedings of the Third International Conference on Asian Digital Library* (113-120). Seoul, Korea.

Jones, S., McInnes, S., & Staveley, M. (1999). A graphical user interface for Boolean query specification. *Internal Journal on Digital Libraries*, Vol. 2, Issue 2/3, pp. 207-223.

Joreskog, K. G., & Sorbom, D. (1996). LISREL 8 User's Reference Guide. Chicago: Scientific Software International.

Jose, J. M., Braddick, H. Martin, I., Robertson, B., Walker, C., & Macpherson, G. (2002). Virtual tutor: A system for deploying digital libraries. In E.

P. Lim, S. Foo, C. Khoo, H. Chen, E. Fox, S. Urs & T. Costantino (Eds.), *Proceedings of 5th International Conference on Asian Digital Libraries* (pp. 275-286). Germany, Springer.

K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic. (2008). Multimedia communication systems: Techniques, Standards, and Networks (3rd Ed.). Pearson Education, Inc. Pearson Prentice Hall.

Kantner, Laurie, and Stephanie Rosenbaum (1997). Usability studies of www sites: Heuristic evaluation vs. laboratory testing. *Proceedings of the 15th Annual International Conference on Computer Documentation*, 153-160. New York: ACM Press.

Kaput, J. (1991). Technology in education research: The first 25 years in the JRME. *Journal for Research in Mathematics Education, 25*, 667-681.

Kassim, A. R. C., & Kochtanek, T. R. (2003). Designing implementing, and evaluating an educational digital library resource. *Online Information Review*, 27 (3), 160-168.

Kaster L, Kirschner PA. Van Merriënboer JJG, Baumer A. (2001). Just-in-time information presentation and the acquisition of complex cognitive skills. *Comput Human Behav*. 17: 373-91.

Kato, T. (1982). Database architecture for content-based image retrieval, in I., K. Sethi and R. J. Jain (eds.), *Image Storage and Retrieval Systems Proceedings of SPIE*, San Jose, CA, USA, Vol. 1662, pp. 112-123.

Kauffman, D., & Hamza, M. K. (1998). Education reform: Ten ideas for change plus or minus two, *Association for the Advancement of Computer in Education SITE Conference*, Washington, D. C.

Kearsley, G.(2000). Learning and teaching in cyberspace. Canada: Wadsworth.

Keefe, J. W. (1987). Learning style theory and practice. Reston, VA: NASSP.

Keefe, J.W. (1979a). Learning styles: An overview. In J. W. Keefe (Ed.), Student learning styles: Diagnosing and prescribing programs (pp. 1-17). Reston, VA: National Association of Secondary School Principals.

Keil, M., Beranek, P. M., & Konsynski, B. R. (1995). Usefulness and ease of use: Field study evidence regarding task considerations. *Decision Support Systems, 13*, 75-91.

Keith, Suzette, Ann Blondford, Bob Fields, and Yin Leng Theng (2003). An investigation into the application of claims analysis to evaluate usability of a digital library interface. Paper presented at the usability workshop of JCDL 2002. http://www.uclic.ac.uk/annb/DLUsability/Keith15.pdf (accessed June 19, 2009).

Kemp, F. (1993). The origins of ENFI, network theory, and computer-based collaborative writing instruction at the University of Texas. In B. Bruce, J. K. Peyton, & T. Baston (Eds.), *Network-based classrooms: Promises and realities* (pp. 161-180). Cambridge, England: Cambridge University Press.

Kim, Kyunghye. (2002). A model of digital library information seeking (DLISP model) as a frame for classifying usability problems. PhD diss., Rutgers University.

Kirschner PA. (2002). Cognitive load theory: implications of cognitive load theory on the design of learning. Learn. Instr. 12: 1-10.

Klavans, J., Hovy, E., Fluhr, C., Frederking, R. E., Oard, D., Okumura, A., Ishhikawa, K., & Sotoh, K. (1999). Multilingual (or cross-lingual) information retrieval. In Multilingual Information Management: Current Levels and Future Abilities (Ch.2). Pisa, Italy: Instituti Editoriali e Polografici Internazionali.

Klem, L. (2000). Structural equation modeling. In L. Grimm & P. R. Yarnold (Eds.), *Reading and understanding MORE multivariate statistics* (pp. 227-260). Washington, DC: American Psychological Association.

Kline, R. B. (2005). *Principles and practice of structural equation modeling* (2nd ed.). New York: The Guilford Press.

Kling, R., & Courtright, C. (2003). Group behavior and learning in electronic forums: a sociotechnical information society. *Information Society, 19*, 221-135.

Knowlton, D. S., & Knowlton, H. M. (2001). The context and content of online discussions: making cyber-discussion viable for the secondary school curriculum. *American Secondary Education 29*, 38-52.

Kolb (1984). In Ramakanta Sahu (2008). An Introduction to Education. (1st Ed) Yemen, Sana'a, Awan Publishers.

Kozma, R. B. (1994). The influence of media on learning: The debate continues. School Library Media Quarterly, 22 (4), 233-240.

Kozma, R. B., & Croninger, R. G. (1992). Technology and the fate of at-risk students. *Education and Urban Society, 24*, 440-453.

Kristmundsson, G. (2000). Betekenisoval leren en nieuwe media. [meaningful learning and new media.] In P. Bemelen & J. Letschert (Eds.), Op de schouders van de voorgangers. Enschede, The Netherlands: SLO.

Kuhlthau, C. C. (1993). Seeking meaning A process approach to library and information services. New Jersey: Ablex Publishing Corporation, Norwood.

Laakaonen, J., Koskela, M., and Oja, E. (1999). PicSOM: self-organizing maps for content-based image retrieval. *Proc. of IEEE Int'l Conf.* Neural Networks, Washington, DC, 1999.

Lancaster, F. W. (1968). Information retrieval systems: Characteristics, testing and evaluation. New York: wiley.

Landau Sabine & Everitt Brian (2004). *A handbook of statistical analyses using SPSS.* USA, Florida, Chapman & Hall/ CRC Press LLC.

Landoni, M. (1997). The visual book system: a study of the use of the visual thetoric in the design of electronic books. Ph.D. Thesis, Department of Information Science, University of Strathclyde, Glasgow, Scotland, UK.

Lapadat J. C. (2002). Written interaction: A key component in online learning. Retrieved April 17, 2009, from http://www.ascusc.org/jcmc/vol7/issue4/lapadat#asynchronous.

Large, A.; Beheshti, J.; Breuleux, A.; & Renaud, A. (1994a). A comparison of information retrieval from print and CD-ROM versions of an encyclopedia by elementary school students. *Information Processing & Management*, 30 (4), 499-513.

Large, A.; Beheshti, J.; Breuleux, A.; & Renaud, A. (1994b). Multimedia and comprehension: A cognitive study. *Journal of the American Society for Information Science*, 45 (7), 515-528.

Larkin JH, Simon HA. (1987). Why a diagram is (sometimes) worth ten thousand words. Cogn Sci. 11: 65-99.

Larson, Ray R. (1994). *Design and development of a network-based electronic library*.(http://sherlock.berkeley.edu/diglib/asis.html). (ray@sherlock.berkeley.edu).

Lawalter D. (2003). Cognitive strategies for learning from static and dynamic visual. Learn Instr. 13: 177-89.

Lebow, D. (1993). Constructivist values for instructional systems design: Five principles toward a new mindset. Educational Technology Research and Development, 41, 4-16.

Lee, J. (1999). Interactive learning with a Web-based digital library system. Prepared for the Ninth DELOS Workshop on Digital Libraries for Distance Learning. http://courses.cs.vt.edu/~cs3604/DELOS.html

Lee, J. H. and Kim, M. H. (1999). Enhancing fuzzy set model for high quality document rankings. *Proceedings of the 19th Euromicro Conference*. Paris. Pp. 337-340.

Lee, K. W. (2000). English teachers' barriers to the use of computer-assisted language learning. *The Internet TESL Journal*. Retrieved July 28, 2009, from http://iteslj.org/Articles/Lee-CALLbarriers.html.

Lesk (1997). In Rama Nand Malviya (2008). Digital Library & Academic Society in India (1st ed.). New Delhi, Asian Books Ptiuate Limited, pp. 2-3.

Leslie Johnston (2005). Development and assessment of a public discovery and delivery interface for a Fedora a repository. *D-Lib Magazine 11 (10)* (2005): 1-13.

Levy , Pierre (2003). Cibercultura na rede. In: MORAES, Denis de. (org). Por uma Outra Comunicacao: media, mundializacao, cultura e poder. Rio de Janeiro: Record.

Levy D. M. (1994). Fixed or fluid? Document stability and new media. *In Proceedings of the 1994 ACM European Conference on Hypermedia Technology*, pages 24-31.

Levy D. M. (1997). I read the news today, oh boy: reading and attention in digital libraries. *In Proceedings of the 2nd ACM International Conference on Digital Libraries*, pages 202-211.

Levy, D. M., & Marshall, C. C. (1995). Going digital: a look at assumptions underlying digital libraries. *Communications of the ACM*, 38 (4), 77-84.

Liaw, S. S., & Huang, H. M. (2003). An investigation of user attitudes toward search engines as an information retrieval tool. *Computer in Human Behavior, 19*, 751-765.

Liebscher, P., & Marcionini, G. (1988). Browse and analytical search strategies in a fulltext CD-ROM encyclopedia. *School Library Media Quarterly*, 16 (4), 223-233.

Liew, C. L., Foo, S., & Chennupati, K. R. (2000). Enhancing user interaction with electronic journals via interactivity and value-adding features. *In Proceedings of the 3rd International Conference on Asian Digital Library*. (pp. 289-294). Seoul, Korea.

Limberg, L., Boras, H. I., & Boras. (1999). Experiencing information seeking and learning: A study of the interaction between two phenomenon. Information Resaerch, 5 (1).

Lim-Youngsook (1996). The Effectiveness of Multimedia Presentation Tools in Teaching Perspective Drawing for Interior Design Students. Unpublished doctoral dissertation, University of Minnesota.

Liu, H. C. (2001). Incorporating computers into English classrooms: Curriculum design issues. In Selected papers from the tenth international symposium on English teaching (pp.120-131). Taiwan: ROC.

Liu, M. Y., & Chen, C. Y. (2004). Acquiring English Relative Clauses. *English Teaching and Learning, 29(1),* 23-52.

Logue, S. (2003). The changing role of libraries in instructional upport. *Information Technology and libraries*, 22 (2), 52.

Lorenzen, M. (2001). Active learning and library instruction. Michigan State University. http://www.libraryreference.org/activebi.html

Lu, Y., Zhang, H., Liu, W. Y. and Hu. C. (2003). Joint semantics and feature based image retrieval using relevance feedback, *IEEE Transactions on Multimedia*, 5 (3): 339-347.

Lynch, Clifford and Garcia-Hector. (1995). (Eds.) Inter-operability, scaling and the digital libraries research agenda. A report on the May 18-19 1995 IITA Digital Libraries Workshop. (Clifford.lynch@ucop.edu) , (hector@db.standford.edu) (http://www.diglib.standford.edu/diglib/pub/reports/iitadlw/main.html).

M. A. Goncalves (2004). Streams, Structures, Spaces, Scenarios, and Societies (5S): A formal digital library framework and its applications, Computer Service Doctoral Dissertation. Blacksburg, VA: Virginia Tech, 2004. 161 pages. http://scholar.lib.vt.edu/these/available/etd-1205-2004-135923/unrestricted/MarcoDissertation.pdf

M. A. Gopinath (1996). Development of a curriculum for digital information systems: A learning package for library and information professionals. *SIS-96*, 18-20, '96, Bangalore.

M. A. Hearst (1996). The changing social roles of documents. Research in Support of Digital Libraries at Xerox PARC, part I. D-Lib Magazine, May 1996. http://www.dlib.org/dlib/may96/05hearst.html.

M. A. Hearst, G. Kopec, and D. Brostky (1996). Paper and digital documents. Research in Support of Digital Libraries at Xerox PARC, part II. D-Lib Magazine, june 1996. http://www.dlib.org/dlib/june96/hearst/06hearst.html.

M. S. Sridhar (1996). Beware of electronic libraries/media. *SIS-96*, 18-20, '96, Bangalore.

MacDonald, J. and Mason, R. (1999). Information handling skills and resource-based learning. Institute of Education Technology, The Open University (UK).

Manjunath, B. S. and Ma, W. Y. (1996). Texture features for browsing and retrieval of image data, *IEEE Transactions on pattern Analysis and Machine Intelligence* 18 (19): 837-842.

Marchionini, G. (1989a). Information seeking strategies of novices using a full-text electronic encyclopedia. *Journal of the American Society for Information Science, 40 (1)*, 54-66.

Marchionini, G. (1995). Information seeking in electronic environment. Cambridge University Press.

Marchionini, G. (2000). Evaluation Digital Libraries: A longitudinal and multifaceted view. *Library Trends, 49*, 304-333.

Marchionini, G. and Shneiderman, Ben. (1988). Finding facts Vs browsing knowledge in hypertext systems. *IEEE Computer*, January, pp. 70-79.

Marchionini, G., Plaisant, C., & Komlodi, A. (2003). The people in digital libraries: Multifaceted approaches to assessing needs and impact. In A. P. Bishop, B. Buttenfield & V. H. N. (Eds.), Digital library use: social practice in design and evaluation. Cambridge: The MIT Press.

Maristella Agosti. (2007). *Information Access Using the Guide of User Requirements*. Springer-Verlag Berlin Heidelberg. pp. 1-10.

Marlion, M., Summer, T. R., Fulker, D., Manduce, C. and Mogk, D. The digital library for Earth system education: building community, building the library. Communication of the ACM, Special Issue on Digital Libraries (May). 80-81.

Marshal, C. C., Price, M. N., Golovchinsky, G., & Schilit, B. N. (1999). Introducing a digital library reading appliance into a reading group. *In Proceedings of ACM DL'99*, pp. 77-84.

Marshall, C. C. (1997). Annotation from paper books to the digital library. In: R. B. Allen, E. Rasmussen (eds.) Proc. *2nd ACM Information Conference on Digital Libraries (DL 1997)*, pp. 233-240. ACM Press, New York, USA.

Marshall, C. C. (1998). Toward on Ecology of hypertext annotation. In: Akscyn (ed.) *Proc. 9th ACM Conference on Hypertext and Hypermedia (HT 1998):* links, objects, time and space-structure in hypermedia systems, pp. 40 -49. ACM Press, New York, USA.

Marshall, C. C., Brush, A. J. B. (2002). From personal to shared annotations. In: Terveen, D. Wixon (eds.) *Proc. Conference on Human Factors and Computing Systems (CHI)* – Extended Abstract on Human Factors in Computer Systems, pp. 812-813. ACM Press, New York, USA.

Marshall, C. C., Brush, A. J. B. (2004). Exploring the relationship between personal and public annotations. In: Chen, H. Wactlar, C. C. Chen, E. P. Lim, M. Christel (eds.) *Proc. 4th ACM/IEEE-CS Joint Conference on Digital Libraries (JCDL)*, pp.349-375. ACM Press. New York, USA.

Mayer, RE, and Moreno, R. (2002) Aids to combuter-based multimedia learning. Learn. Instr., 12. 107-119.

McAlister S., Ravenscroft, A., & Scanlon, E. (2004). Combining interaction and context design to support collaborative argumentation using a tool for synchronous CMC. *Journal of Computer Assisted Learning, 20,* 194-204.

McCown, F., Bollen, J., & Nelson, M. L. (2005). Evaluation of the NSDL and Google for obtaining pedagogical resources. *In Proceedings of the ECDL 2005*. Lecture notes in computer science 3652 (pp. 344-355).

McDonald, J. (2002). Is "as good as face-to-face" as good as it gets? *Journal of Asynchronous Learning Networks,* 6, 10-23.

McDonald, M. (1996). The impact of multimedia instruction upon student attitude and achievement and relationship with learning styles. Unpublished doctoral dissertation, University of Nebraska-Lincoln. Dissertation Abstracts International, 57 (08A), 3466.

McNally, M. J. & Kuhlthau, C. C. (1994). Search process in science education. Reference Library, 44 (1), 53-60.

Means, B., Ed. (1994). *Technology and education reform*. San Francisco, CA: Jossey-Bass.

Means, B., Olson, K. (1997). *Technology and education reform*. Retrieved July 8, 2004, from http://www.ed.gov/pubs/SER/Technology/title.html.

Mehrotra, R. and Gary, J. E. (1995). Similar-shape retrieval in shape data management, *IEEE Computer* 28 (9): 5762.

Meyers, L., S., Gamst, G., & Guarino, A. J. (2006). Applied Multivariate Research: Design and Interpretation. Thousand Oaks, CA: Sage Publication, Inc.

Michael G. Christel, David B. Winkler, C. Roy Taylor (1997). Multimedia abstractions for a digital video library. *In Proceedings of ACM Digital Libraries'97 Conference*, Philadephia, PA, pp.21-29.

Microsoft (2003). Microsoft's case study on IVLE. Retrieved October 2, 2003, from Microsoft's in Education on the World Wide Web: http://www.bpghs.wizlearn.net/public/case-study.html.

Michael Lesk (2005). Understanding Digital Libraries. 2nd edition, (pp. 9-12).

Michal Kosiedowski, Cezary Mazurek, Maciej Stroinski, Marcin Werla, Marcin Wolski (2007). Federating digital library services for advanced applications in science and education. *Computational Methods in Science and Technology* 13(2), 101-112 (2007).

Monopoli, M., Nicholas, D., Georgiou, P., & Korfiati, M. (2002). A user-oriented evaluation of digital libraries: Case study: The "electronic journals" service of the library and information service of the University of Patras, Greece. Aslib Proceedings, 54 (2), 103-117.

Morgan, W., & Beaumont G. (2003). A dialogic approach to argumentation: Using a chat room to develop early adolescent students' argumentative writing. *Journal of Adolescent & Adult Literacy, 47,* 146-158.

Mueller, D. (1986). *Measuring social attitudes: A handbook for researchers and practitioners.* New York, NY: Teacher College Press.

Munro T. and Pringle I. (2009). Using Open and Distance Learning for Community Development. (In: Baksh R. and Munro T. (2009). Learning to Live Together Using Distance Education for Community Peace building, Commonwealth of Learning, Vancouver)

Mylonas, E. (1992). An interface to classical Greek civilization. *J. Am. Soc. Inf. Sci. 43(2)*, 192-201.

Natalie Lee-San Pang (2005). Digital libraries as learning environments for Youths. INFOSCI.

National Science Digital Library (n.d.) National Science Digital Library. Retrieved March 13, 2009, from http://nsdl.org/

Nelson, J., Hayes, J. R. (1988). How the writing context shapes college students' strategies for writing from source. Technical Report no. 16. Center for the study of writing. Berkeley, CA: University of California.

Neuman, D. (1993). Designing databases as tools for higher-level learning: Insights from instructional systems design. Educational Technology Research and Development, 41 (4), 25-46.

Neuman, D. (1995a). High school students' use of databases: Competing conceptual structures. Unpublished paper presented at the Annual Meeting of the American Society for International Science, Chicago.

Neuman, D. (1995b). High school students' use of databases: Results of a national Delphi study. *Journal of the American Society for International Science*, 46 (4), 284-298.

Nicole Compbell (2001). Usability Assessment of Library-Related Web Sites: Methods and Case Studies. American Library Association. Chicago, Illinois, 2001 p.125.

Nielsen (2003). Usability 101: Introduction to usability. Useit.com: Usable Information Technology. Use Net Alterbox, August. Disponivel em: http://www.useit.com/alterbox/20030825.html.

Nielsen, J. (1993). Usability Engineering. San Diego, CA: Academic Press.

Nielson, Jakob, and Robert L. Mack, eds. (1994). *Usability inspection methods*. New York: Wiley

Norman, Donald A., Draper, Stephen W. (1986). Cognitive Engineering. User-Centered-System Design: new perspective on Human-Computer-Interation. New Jersey.

O'Hara, K. O., Smith, F., Newman, W., & Sellen, A. (1998). Student readers' use of library documents: implications for library technologies. *In Proceedings of CHI'98*, pp. 233-240.

O'Malley J. M., Chamot A. U., Stewner-Manzares G., Kupper L. and Russo R. P. (1985a). 'Learning strategies used by beginning and intermediate ESL students'. *Language Learning, 35*(1), 21-46.

Oard, D. W., & Dorr, B. J. (1996). A survey of multilingual text retrieval text retrieval. UMIACS-TR-96-19-CS-TR-3815.

Oddy, R. N. (1977). Information retrieval through Man-Machine dialogue. *Journal of Documentation*, 33; pp. 1-4.

Oldyzko, A. M. (1994). Tragic loser good riddance? *The impending demise of* *traditional scholarly journal*. Notice of the AMS.

Ong, T. H., & Chen, H. (1999). Updateable PAT-Tree approach to Chinese key phrase extraction using mutual information: A linguistic foundation for knowledge management. *In Proceedings of the 2nd Asian Digital Library Workshop:* (pp. 63-84). Taipei, Taiwan.

Oppenheim, C. & D. Smithson (1999). What is the hybrid library? *Journal of Information Science*, 25 (2): 97-112.

Owen, C., G., Sunderraman, R., Zhang, Y. (2000). *The development of a digital library to support the teaching of computer graphics and visualization*. Computer & Graphics 24(4): 623-627.

Pamela Gore & Sandra Hirsh (2003). Planning your way to a more usable Web site. *Online (Weston, Conn)* 27 (3) (2003): 20-2 – 24-7.

Panitz, T. (1999). *The case for student centered instruction via collaborative learning paradigms.* Retrieved July 22, 2009, from http://home.capecod.net/~tpanitz/tedsarticles/coopbenefits.htm.

Park, I. & Hannafin, M. J. (1993). Empirically based guidelines for the design of interactive multimedia. Educational Technology Research and Development, 41 (3), 63-85.

Pearrow, Mark (2000). *Web site usability handbook.* Rockland, MA: Charles River Media.

Perkings, D. N. (1991). What constructivism demands of the learner. Educational Technology, 31 (9), 19-21.

Perzylo, L., & Oliver, R. (1992). An investigation of children's use of a multimedia CD-ROM product for information retrieval. Microcomputers for Information Management, 9 (4), 225-239.

Picard, R. W. and Minka, T. P. Vision texture for Annotation, technical report, MIT Media Laboratory, No. 302. available at http://citeseer.nj.nec.com/picard95vision.html.

Pilkington, R., & Bennett, C. (2000). An evaluation of computer mediated communication to support group discussion in continuing education. *Educational Technology & Society, 3,* 349-360. Retrieved April, 9, 2008, from http://ifets.massey.ac.nz/periodical/vol_3_2000/d10.pdf.

Plass, J. L., & Homer, B. D. (2002). Cognitive load in multimedia learning: The role of learner preferences and abilities. Paper accepted for presentation at the International Conference on Computers in Education (ICCE) in Auckland, New Zealand.

Pogrow, S. (1994). Helping students who just don't understand. *Educational Leadership,* 52 (3), 62-66.

Ponte, J. M., & Croft, W. B. (1998). A language modeling approach to information retrieval. *Proceedings of ACM SIGIR Conference on Research and Development in Information Retrieval,* pp. 275-281.

Poole, D. M. (2000). Student participation in a discussion-oriented online course: A case study. *Journal of Research on Computing in Education, 33,* 162-177.

Popkiewicz, T. S. (2000). The denial of change in educational change: Systems of ideas in the construction of national policy and evaluation. *Educational researcher*, 29(1), 17-29.

Popp, Mary Pagliero (2001). Testing library Web sites: ARL libraries weigh in. Paper presented at the Association of College and Research Libraries, 10th National Conference, Denver, Color-ado, March 15-18, 2001. http://www.ala.org/ala/acr/acrlevents/popp.pdf.

Purbo, O. W. (2004). When east meet west: In ICT4D. IDRC Sabbatical paper. Retrieved March 25, 2004, from the World Wide Web: http://sandbox.bellanet.org/~onno/ict4d-roadmap/when-east-meet-west-in-ict4d-doc

R. Kengeri, C. D. Seals, H. P. Reddy, H. D. Harley, and E. A. Fox (1997). Usability study of digital libraries: ACM, IEEE-CS, NCSTRL, NDLTD, December 1997. http://fox.cs.vt.edu/~fox/u/Usability.pdf. (9 June 2009).

Radecki, T. (1979). Fuzzy set theoretical approach to document retrieval. *Information Processing and Management*, 15 (5), 247-259.

Rama Nand Malviya (2008). Digital Library & Academic Society in India: Features of digital libraries. Kamal Jagasia for Asian Books Pvt. Ltd. New Delhi. (p.7).

Rama Nand Malviya (2008). Digital Library & Academic Society in India: Advantages of Digital Library. Kamal Jagasia for Asian Books Pvt. Ltd. New Delhi. (p. 8).

Rapp, D. N., Taylor, H. A. and Grane, G. R. The impact of digital libraries on cognitive processes: psychological issue of hypermedia. Computers in Human Behavior, 19, 609-628.

Recker, M., Dorward, J., Dawson, D., Halioris, S., Liu, Y., Mao, X., et al. (2005a, June). *You can lead a horse to water: Teacher development and use of digital library resources*. Paper presented at the Fifth ACM/IEEE Joint Conference on Digital Libraries, Denver, CO.

Recker, M., Dorward, J., Dawson, D., Mao, X., Liu, Y., Palmer, B., et al. (2005b). Teaching, designing, and sharing: A context for learning objects. *Interdisciplinary Journal of Knowledge and Learning Objects, 1*, 197-216.

Recker, M., Dorward, J., Nelson, L. (2004). Discovery and use of online learning resources: Case study findings. *Educational Technology and Society*, 7(2), 93-104.

Reinert, H. (1976). The Edmonds learning style identification exercise. Edmonds, WA: Edmonds School District.

Renda, M. E., & Straccia, U. (2002). A personalized collaborative digital library environment. In Proceedings of the 5th International Conference on Asian Digital Library. (pp. 262-274). Singapore.

Renninger, K. A. and Shumar, W. (2002). Community building with and for teachers at the Math Forum. In Renninger, K. A. and Shumar, W. eds. Building virtual communities: Learning and change in cyberspace, Cambridge University Press, New York, 60-95.

Rieber, L. P. (1990). Using computer animated graphics in science instruction with children. Journal of Educational Psychology, 82, 135-140.

Rieber, L. P. (1996). Computer-based microworlds: A bridge between constructivism and direct instruction. Educational Technology Research ◻ Development, 40 (1), 93-106.

Robertson, S. E. (1977). The probability ranking principle in IR. *Journal of Documentation,* 33; pp. 249-304.

Rong Zhao and William I. (2002). Grosly (2002). Narrowing the semantic gapimproved text-based Web Document Retrieval Using Visual Features, *IEEE Transaction on Multimedia,* 4 (2): 189-200.

Rosson, M. B., and J.M. Carrol (2002). *Usability engineering: Scenariio-based development of human-computer interaction.* San Francisco: Morgan Kaufmann.

Rui, Y., and Huang, T. S. and Chang S. F. (1999). Image retrieval: Current Techniques, Promising Directions and Open Issues. *Journal of Visual Communication and Image Representation* 10 (4): 39-62.

S. I.·Fazzuludin and Chikkamallaiah. (1996). The implications of Internet on Indian library network system. *SIS-96*, 18-20, Jan. '96, Bangalore.

Sahu Rama Kanta (2008). *An Introduction to Education*, (1st Ed). Yemen, Sana'a, Awan Publishers.

Salmon G. (2000). *E-moderating: The Key to Teaching and Learning Online.* London: Kogan Page.

Salomon, G. (1992a). The changing role of the teacher: From information transmitter to orchestrator. In F. K. Oser, A. Dick, & J-L. patty (Eds.), Effective and responsible teaching: The new synthesis (pp. 35-49). San Francisco: Jossey-Bass.

Salomon, G. (1992b). Effects with and of computers and the study of computer-based learning environments. In E. De Corte, M. C. Linn, H. Mandl, & L. Versehaflel (Eds.), Computer-based learning environments and problem solving (pp. 249-263). Berlin, Germany: Rpring-Verlag.

Salton, G. (1963). Associative document retrieval techniques using bibliographic information. *Journal of the ACM* 10, 440-457.

Salton, G. (1979). Mathematics and information retrieval. *Journal of documentation.* 35 (1), pp. 1-29.

Salton, G. and Fox, E. A. (1985). Extended Boolean information retrieval communication of the ACM. 32 (11), pp. 200-210.

Salton, G., Yong, C. S., & Wong, A. (1975). A vector-space model for automatic indexing. Communications of the ACM, 18 (11), 613-620.

Santa Monica, Calif. (1994). Getty Art History Information Program, The American Council of Learned Societies, and The Coalition for Networked Information. Humanities and Arts on the Information Highway: A profile. Getty Art History Information Program.

Santini, S. (2002). Multimodal search in collections of images and text. *Journal of Electronic Imaging* 11 (4): 455-468.

Sarason, S. B. (1971). *The culture of the school and the problem of change.* Boston: Allyn and Bacon, Inc.

Scardamalia, M.; Berreiter, C.; Brett, C.; Burtis, P. J.; Calhoun, C.; & Smith, L. N. (1992). Educational applications of a networked communal database. Interactive Learning Environments, 2 (1), 45-71.

Scardamalia, M.; Berreiter, C.; McLean, R.; Swalow, J.; & Woodruff, E. (1989). Computer-supported international learning environments. *Journal of Educational Computing Research*, 5, 51-68.

Schaffner, A. (1994). The future of scientific journals: Lessons from the past. *Inf. Technol. Libr. 13(4)*, 239-247.

Schnotz, W. (2002). Towards an integrated view of learning from text and visual displays. Educ. Pschol. 14, 20-101.

Schultz, R. A. (2003). *The effectiveness of online synchronous discussion.* Retrieved April 9, 2009 from http://ecommerce.lebow.drexel.edu/2003Proceedings/docs/077Schul.pdf

Sclaroff, S., La Cascia, M., Sethi, S., and Taycher, L. (1999). Unifying textual and visual cues for content-based image retrieval on the World Wide Web, Computer vision and image understanding, 4 (2): 86-98, 1999.

Scott Steven, DEAN Zollman, Michal Christel, Brian Adrian (2007). Virtual Pedagogical Agents as Aids for High School Physics Teachers. ICL Conference, September 26-28, 2007 Villach, Austria.

Scott Steven, DEAN Zollman; Michal Christel, Brian Adrian (2007). Virtual Pedagogical Agents as Aids for High School Physics Teachers. ICL Conference, September 26-28, 2007 Villach, Austria.

Sheingold, K. (1990). Restructuring for learning with technology: The potential for synergy. In K. Sheingold & M. S. Tucker (Eds.), Restructuring for learning with technology (pp. 9-27). New York:Center for technology in Education, Bank Street College of Education.

Shenton, A. K., & Dixon, P. (2003). Models of young people's information seeking. *Journal of Librarianship and Information Science*, 35 (1), March.

Shenton, A. K., & Dixon, P. (2004). Issues arising from youngest' information-seeking behavior. *Library and Information Science Research*, 26, 177-200.

Shipman, F., Price, M. N., Marshall, C. C., Golovchinsky, G. (2003). Identifying useful passages in documents based on annotation patterns. In: T. Koch, I. T. Sølvberg (eds.) *Proc. 7th European Conference on Research and Advanced Technology for Digital Libraries (ECDL)*, pp. 101-112. Lecture Note in Computer Science (LNCS) 2769, Springer, Heidelberg, Germany.

Shneiderman, B. (1998). Designing the user interface strategies for effective human-computer interaction (3rd ed). Reading, MA: Addision-Wesley.

Sliwa, S. (1994). Reengineering the learning process with information technology. *Academic*, 80, 8-12.

Small, R. V., & Ferreira, S. M. (1994). Multimedia technology and the changing nature of research in the school library. Reference Librarian, 44, 95-106.

Smeaton, A. F., & Callan, J. (2005). Personalization and recommender systems in digital libraries. *International Journal on Digital Libraries*, 5 (4), 299-308.

Smeaton, A., & Callan, J. (2002). Joint delos-nsf workshop on personalization and recommender systems in digital libraries (No. April 21).

Smeulders, A., Worring, M., Santini, S., Gupta A., and Jain R. (2000). Content-based image retrieval at the end of the early years, *IEEE Trans. PAMI,* December 2000, pp.1349-1380.

Smith, A. G. (1998). Criteria for evaluation of Internet resources in a digital library environment. In Proceedings of the 1st Asian Digital Library Workshop. (pp. 81-87). Hong Kong.

Smith, D. A. A., R. J., J. P. (1993). Misconceptions reconceived: A constructivist analysis of knowledge in transition. Journal of the Learning Sciences, 3 (2).

Smith, T., Janee, G., Frew, J., & Coleman, A. (2001). The Alexandria Digital Earth Prototype system. In E. Fox & C. Borgman (Eds.), *Proceedings of the First ACM + IEEE Joint Conference on Digital Libraries* (pp. 118-119). New York: ACM Press.

Snoeyink, R., & Ertmer, P. G. (2001-2002). Thrust into technology: How veteran teachers respond. *Journal of Educational Technology Systems*, 30(1), 85-111.

Snyder, Carolyn (2003). Paper prototyping: *The fast and easy way to design and refine user interfaces.* Boston: Morgan Kaufmann.

Snyder, I. (1998). Beyond the hype: reassessing hypertext. In I. Snyder (Ed.), Page to screen: Taking literacy in the electronic era. London/New York: Routledge.

Soloman, P. (1993). Children's information retrieval behavior: A case analysis of an OPAC. *Journal of the American Society for Information Science*, 44 (5), 245-263.

Soloman, P. (1994). Children, technology, and instruction: A case study of elementary school children using an online public access catalog (OPAC). School Library Media Quarterly, 23 (1), 43-53.

Soloway, E., Guzdial, M., & Hay, K. E. (1994, April). Learner-centered design: The challenge for HCI in the 1st Century. Interaction, 36-48.

Song, C. R. (2002). Literature review for hypermedia study from an individual learning perspective. *British Journal of Education Technology, 33(4)*, 435-447.

Sowa, J. F. (2000). Knowledge representation: Logical, Philosophical and Computational foundation. Pacific Grove, USA: Thomson Learning.

Stelmaszewska, H., & Blandford, A. (2004). From physical to digital: A case study of computer scientists' behavior in physical libraries. *International Journal on Digital Libraries, 4(2)*, 82-92.

Stevens, C. (1993). Knowledge-based assistance for handling large, poorly structured information spaces. Ph.D. dissertation Univ. of Colorado at Boulder. Teac. Rep. CU-CS-640-93.

Sue Roberts (2006). Partner or Pariah? : Future roles for libraries in learning and teaching. Ticer International Summer School 'Digital Librarie a/a Carte' 21-25.

Sueil Mara Ferreira, Denise Nunes Pithan (2005). Usability of digital libraries: a study based on the areas of information science and human-computer-interaction. IFLA General Conference and Council, Oslo, Norway.

Sumner, T., & Dawe, M. (2001). Looking at digital library usability from a reuse perspective. *In Proceedings of Joint Conference of Digital Libraries* (pp. 416-425). New York: ACM.

Susan M. Ryan (2003). Library Web site administration: A strategic planning model for the small academic library. *The Journal of Academic Librarianship 29* (4) (2003): 207-218.

Susan Thompson (2003). Remote observation strategies for usability testing. *Information Technology and Libraries 22* (1) (2003, March): 22-32.

Sushan Dhakal (2007). Open digital library, implementation in open educational perspective. *Kathmandu University Journal of Science, Engineering and Technology*, Vol. I, No. III, Journal, 2007.

Sweller J, Van Merriënboer JJG, Pass FGWC. (1998). Cognitive architecture and instructional design. Educ Psychol Rev. 1998; 10: 251-96. August 2009. Available in URL: www.ticer.nl/06carte/publicat/13Roberts.pdf.

T. B. Rajashekar (1996). Digital Libraries: Attributes and architecture. *SIS*-96, 18-20, '96, Bangalore.

Tabachnick, B. & Fidell, L. (1996). *Using multivariate statistics*. New York, NY: Harper Collins College Publishers.

Tabachnick, B. G., & Fidell, L. S. (2001). Using multivariate statistics (4th ed). Boston. MA: Allyn & Bacon.

Tague-Sutcliffe, J. (1992). The pragmatics of information retrieval experimentation, revisited. *Information Processing and Management*, 88(4), 467-490.

Tamura, H., Mori, S., Yamawaki, T. (1978). Textual features corresponding to visual perception, *IEEE Trans.* On System, Man and Cybernetics 8 (6).

Tane, J., C. Schmit, G. Stumme. S. Staah & R. Studer (2003). The Courseware Watchdog: an Ontology-based tool for finding and organizing learning material. In Fachtagung Mobiles Lernen and Forschen.

Teal Anderson and Sayeed Choudhury (2008). A Usability Research Agenda for Digital Libraries (Baltimore, Maryland: The Digital Knowledge Center Sheridan Libraries, John Hopkins University. http://dkc.jhu.edu/~teal/usability_research_agenda.html. 13 August 2008).

Technology Based Learning & Research (1998). *Mathedology* on CD-ROM. Tempe, AZ: Arizona State University.

Terence R. Smith, Lesk (1997). In Rana Nand Malviya (2008). Digital Library & Academic Society in India, (pp. 2-3).

Theeramunkong, T., Wongtapan, C., & Sinthupinyo, S. (2002). Offline isolated handwritten Thai OCR using island-based projection with n-gram models and hidden Morkov Models. *In Proceedings of the Fifth International Conference on Asian Digital Library* (pp. 340-351). Singapore.

Theng, Y. L., Mohd-Nasir, N., Buchanan, G., Fields, B., & Thimbleby, H. (2001). Dynamic digital libraries for children. In E. Fox & C. Borgman (Eds.), *Proceedings of ACM/IEEE Joint Conference on Digital Libraries* (pp. 406-415). Roanoke, VA: ACM Press.

Thomas, Gwenda (2000). South African virtual library environment: how do we square this circle. [Online] available (Accessed 9 July 2001) WWW: http://www.sun.ac.za./library/Sys2000/thomas.html

Thomas, M. (1995). The effects on achievement scores using dissonant and matched treatments of learning style and/or mastery learning. Unpublished doctoral dissertation, University of Wisconsin-Madison. Dissertation Abstracts International, 57(01A), 93.

Thomas, Rita Leigh (1998). Elements of performance and satisfaction as indicators of the usability of digital spatial interfaces for information-seeking: implications for ISLA. PhD diss., University of Southern, California.

Thompson, B. & Daniel, L. (1996). Factor analytic evidence for the construct validity of scores: A historical overview and some guidelines. *Educational and Psychological Measurement, 56(2)*, 197-208.

Tian, Q., Hong, P., and Huang, T. S. (2000). Update relevant image weights for content-based image retrieval using support vector machine. *Proc. of IEEE Int'l Conf.* Multimedia and Expo, Vol. 2, NY, 2000, pp. 1199-1202.

Tieu, K., and Viola, P. (2000). Boosting image retrieval. *Proc. of IEEE Conf.* CVPR, June 2000.

Timothy E. Morse (2004). Ensuring equality of educational opportunity in the digital age. *Education and Urban Society, 36*(3), 266-279.

Tong, S., and Chang, E. (2001). Support vector machine active learning of image retrieval. *Proc. of ACM Int'l Conf.* Multimedia, Ottawa. Canada, Oct. 2001, pp. 107-118.

Tosey, P., & Gregory, J. (1998). The peer learning community in higher education: Reflections on practice. *Innovations in Education and Training International, 35(1)*, 74-81.

Turtle, H., & Croft, W. B. (1991). Evaluation of an inference network-based retrieval model. *ACM Translations on Information Systems*, 9 (3), 187-222.

Twidale, M. B. et al. (2007). Writing in the library: Exploring tighter integration of digital library use with the writing process, *Information Processing and Management* (2007), doi:10.1016/j.imp.2007.05.010.

U. S. Department of Commerce. (2000). *Falling through the Net: Toward digital inclusion*. Washington, DC: Author. Retrieved June 4, 2009, from http://www.ntia.doc.gov.ntiahome/digitaldivide/

U.S. Congress Office of Technology Assessment. (1995). *Teachers & technology: Making the connection.* Washington, DC: U.S. Government Printing Office.

UNECA. (2003). Digital libraries and virtual libraries: Definitions, Concepts, and Goals. Workshop on Technical Aspects of Building Digital Libraries and Electronic Information Networks. L/ECA/DISD/AVLIN/9.

Vaidya, B., & Shrestha, J. N. (2000). Rural digital library: Connecting rural communities in Nepal. *In Proceedings of the 5th International Conference on Asian Digital Library.* (pp. 354-365). Singapore.

Vakkari, P. (2000). Relevance and contributing information types of searced documents in task performance. In Proceedings of the 23rd annual International ACM SIGIR Conference on Research and Development in Information Retrieval. Athens, Greece; ACM Press.

Vakkari, P. (2001). A theory of the task based information retrieval process: A summary and generalization of a longitudinal study. *Journal of Documentation,* 57 (1), 44-60.

Van House, N. A., Butler, M. H., Ogle, V., & Schiff, L. (1996, February). User-Centered iterative design for digital libraries: the Cypress experience. D-Lib Magazine, 2, Retrieval February 3, 2009, from http://www.dlib.org/dlib/february96/02vanhouse.html.

Van Rijsbergen, C. J. (1979). Information retrieval. Butterworths.

Vasconcels, N., and Lippman, A. (2000). Bayesian relevance feedback for content-based image retrieval. *Proc. of IEEE Workshop on Content-based Access of Image and Video Libraries,* CVPR.

Vergara, M. N. Capuano & E. Sangineto (2003). Diogene: a Training Web Broker for ITC Professionals, in 2nd Int. Conference on Multimedia and ICT in Education (m-ICTE 2003) Badajoz, Spain, 330-4.

Vickery, B. C. (1970). Techniques of Information Retrieval. London: Butterworth's.

Vijay Gupta (1999). SPSS for Beginners. (1st Ed.), VJBooks Inc.

Vrasidas, C. (In press). Constructivism versus objectivism: Implications for interaction, course design, and evaluation in distance education. *International Journal of Educational Telecommunications.*

Vrasidas, C., McIsaac, M. (2001). Integrating technology in teaching and teacher education: Implications for policy and curriculum reform. *Educational Media International, 38*(2/3), 127-132.

W. K. Alistair, Hall H., A. K. Stephen (2002). Doing Statistics with SPSS (1st ed). SAGE Publications, London, Thousand Oaks, New Delhi.

Walfram, D., & Xie, H. (2001). State digital libraries: Development systems for general audiences. *In Proceedings of the 4th International Conference on Asian Digital Library.* (pp. 62-74). Bangalore, India.

Walker, S. A. (2004). Socratic strategies and devil's advocacy in synchronous CMC debate. *Journal of Computer Assisted Learning, 20,* 172-182.

Wallace, D. R., & Mutooni, P. (1999). A comparative evaluation of World Wide Web-based and classroom teaching. *Journal of Engineering Education, 86*(3), 211-219.

Wallace, R. M. (2004). A framework for understanding teaching with the Internet. *American Educational Research Journal, 41(2)*, 447-488.

Wallace, R., Soloway, E., Krajcik, J., Bos, N., Hoffman, J., Hunter, H. E., et al. (1998). Artemis: Learner-centered design of an information seeking environment for k-12 education. In Chi pp. 195-202. Los Angeles, CA, USA.

Walters, Donald j. (1998). What are digital libraries? CLIR Issues, No. 4, July/August. [online] Available WWW: (Accessed 9 July 2009) http://www.clir.org/pubs/issues/issues04.html # dly.

Warschauer, M. (1995). *E-mail for English teaching*. Alexandria, Virginia: TESOL Publications, Inc.

Warschauer, M. (1998). Research technology in TESOL: Determinist, instrumental, and critical approaches. *TESOL Quarterly, 32*, 757-762.

Waters (1992). In Rama Nand Malviya (2008). Digital Library & Academic Society in India (1st ed.). New Delhi, Asian Books Ptiuate Limited, pp. 2-3.

Watson, J. S. (1998). "If you don't have it, you can't find it." A close look at student's perceptions of using technology. *Journal of American Society for information Science*, 49 (11), 1024-1036.

Wattenberg, F. (1998). *A national digital library for science, mathematics, engineering, and technology education*. Retrieved December 29, 2008, from http://www.dlib.org/dlib/october98/wattenberg/10wattenberg.html#contents.

Waxman, H. C., & Bright, G. W. (1993). Research methods and paradigms in technology and teacher education. In H. C. Waxman & G. W. Bright (Eds.) Approaches to research in teacher education and technology (pp. 1-9). Charlottesville, VA: Association for the Advancement of Computers and Education.

Wenden A. (1983). 'The process of intervention'. *Language Learning, 33*(1), 21-103.

Wenden A. (1986). 'What do second language learners know about their language learning?: A second look at retrospective accounts'. *Applied Linguistics, 7*(2), 0-186.

Wenden A. (1987a). ' How to be a success full language learner: Insights and prescriptions from L2 learners'. In Wenden and Rubin (Eds.).

Westerveld, T. (2000). Image retrieval: content versus context. *Proceedings of computer-assisted information retrieval*, Vol. 1, Paris, France, pp. 276-284, 2000.

Wiburg, K. M. (1991). Teaching teachers about technology. *Computers in the schools* 8 (1/2/3), 115-129.

Wiburg, K. M. (1997). The dance of change: Integrating technology into classrooms. *Computers in the Schools*, 13, 171-184.

Wilmsen T, Hartog R, Bisseling T. (2002). Web based learning support for experimental design in molecular biology: a top-down approach. *Journal of Interactive Learning Research*. 14: 301-14.

Wilson, B. (1991). Technology in higher education: in search of progress in human learning. *Educational Record*, 75, 8-16.

Wilson, T. (1999). Models in information behavior research. *Journal of documentation*. 55 (3), 249-270.

Windschitl, M. (1998). The WWW and classroom research: what path do we take? *Educational Researcher*, 27(1), 28-33.

Windschitl, M. (2000). Using the WWW for teaching and learning in k-12 classrooms: what are the interesting research questions? *cyberPsychology & Behavior*, 3 (1), 89-96.

Witten, I. H. (2002). Example of practical digital libraries: Collections built internationally using Greenstone. In Proceedings of the 5th International Conference on Asian Digital Library Workshop. (pp. 67-74). Singapore.

Witten, I. H., & Bainbridge, D. (2002). How to build a digital library. San Francisco: Morgan Kaufmann.

Witten, I. H., Loots, M., Trujillo, M. F., & Bainbridge, D. (2002). The promise of digital libraries in developing countries. *The Electronic Library*, 20 (1), 7-13.

Wixom, B. H., & Todd, P. A. (2005). A theoretical integration of user satisfaction and technology acceptance. *Information Systems Research, 16(1)*, 85-102.

Wong, K. L., Lam, W., & Yen, J. (1999). Interactive Chinese news event detection and tracking. *In Proceedings of the 2nd Asian Digital Library Workshop*. (pp. 30-46). Taipei, Taiwan.

Wu, S. and Witten, I. H. (2006). Towards a digital library for language learning. *Proc European Conf. on Digital Libraries*. Pp. 341-352, Alicante. Spain.

Wu, Y., Tian, Q., and Huang, T. S. (2000). Discriminant EM algorithm with application to image retrieval *Proc. of IEEE Conf.* Computer Vision and Pattern Recognition.

Xie, H. I. (2008). Users' evaluation of digital libraries (DLs): Their uses, ---, *Information Processing and Management* (2008), doi:10.1016/j.imp.2007.10.003.

Yang, C. & Li, K. Wing (2005). Cross-lingual information retrieval: The challenges in multilingual digital libraries. In: Croft, W. B. (2008). Information Access Through Search Engines and Digital Libraries (Eds.), Springer.

Yang, C. and Lozano-Perez, T. (2003). Image database retrieval with multiple-instance learning techniques. *Proc. of the 16th Int'l Conf.* Data Engineering, Santa Diego, CA, 2003.

Yang, C. C., Yen, J., Yung, S. K., & Chung, A. K. L. (1998). Chinese indexing using mutual information. *In Proceedings of the First Asian Digital Library Workshop* (57-64). Hong Kong.

Yang, S. C. (2001). An interpretive and situated approach to an evaluation of Perseus digital libraries. *Journal of the American Society for Information Science and Technology*, 52, 1210-1223.

Yoshitaka, A. and Ichikawa, T. (1999). A survey on content-based retrieval for multimedia databases, *IEEE Transactions on knowledge and Data Engineering 11* (1): 81-93.

Young-Shwu-Ching, (1996). A study of learner's instructions with and perceptions of a CD-ROM based instructional program on interactive writing. Unpublished doctoral dissertation, Ohio State University. Dissertation Abstracts International, 57 (07A), 2985.

Yu. (2004). Statistical learning approaches to information filtering, Dissertation, LMU Munich.

Zhao, Y., Pugh, K., Byers, J., & Sheldon, S. (2002). Conditions for classroom technology innovations. *Teachers College Record, 104(3)*, 482-515.

Kerr A. W., Hall, H. K., Kozub S. A. (2002). Doing statistics with SPSS. SAGE Publications Ltd. London.

Zia, L. (2001). *Growing a national learning environments and resources network for science, mathematics, engineering, and technology education: Current Issues and Opportunities for the NSDL program.* Retrieved July 17, 2009, from http://www.dlib.org/dlib/march01/zia/03zia.html.

CHAPTER1 INTRODUCTION

http://www.dli2/nsf/gov/
http://www.dli2/nsfs/gov/projects.html
http://www.dli2/nsf/gov/itrprojects.html
http://www.dli2/nsf/gov/intl.html
http://www.imls.gov/about/index.html
http://www.imls.gov/closer/cls_po.asp
http://www.nsdl.nsf.gov/indexx.html
http://fuzine.mt.cs.cmu.edu/im/informedia.html
http://sils.umich.edu/UMDL/Homepage.html
http://http.cs.berkeley.edu/~wilensky
http://www.diglib.stanford.edu/diglib
http://cedr.lbl.gov/cdrom/doc/cdrom.html
http://www.yemen.nic.info

CHAPTER 2 LITERATURE REVIEW

http://www.merlot.org/Home.po
http://www.mathdl.org/
http://www.compadre.org/
http://www.microbelibrary.org/
http://thelearningmatrix.enc.org
http://turing.bear.uncw.edu/iLumina/index.asp
http://www.eskeletons.org/
www.sciencedirect.com
www.alexanderestreetprees.com/clmu.html

CHAPTER 3 CONCEPTUAL FRAMEWORK

Section (3.1) information retrieval (IR)

www.sapir.eul

CHAPTER 4 METHODOLOGY

http://www.berkeley.edu/

Appendix A

QUESTIONNAIRE

Usability Testing Questions:

Dear Student,

Will you kindly fill the enclosed evaluation form for digital library's Web-Site?

We hope, your response together with our own assessment will contribute to the improvement of our future programs. I will ask you a series of questions and would like you to think out loud while you look for the answer. Some questions are easy and some more difficult. Do not worry if you can not find the answer every time.

Please, remember that we are testing the effectiveness, learning activities of the site design and this is not a test you.

The whole test should take less than 2 hours.

I Thank You.

1-) does the library have a paper copy of

a-) education history?

☐Yes ☐No ♦ time: ♦No. of mouse click:

b-) different places, different people?

☐Yes ☐No ♦time: ♦No. of mouse click:

c-) what use in economic theory?

☐Yes ☐No ♦time: ♦No. of mouse click:

d-) history of social theory?

☐Yes ☐No ♦time: ♦No. of mouse click:

e-) teaching English to the world?

☐Yes ☐No ♦time: ♦No. of mouse click:

Please, rank from 1 to 5 regarding the ease of the system, 1 being the easiest and 5 being the full difficult.

♦full easy to use=1 ♦easy to use=2 ♦medium=3

♦difficult=4 ♦full difficult=5

2-) use a database to find an audio about:

a-) English subject?
♦time: ♦No. of mouse click:

b-) philosophy?

♦time: ♦No. of mouse click:

c-) history?

♦time: ♦No. of mouse click:

d-) geography?

♦time: ♦No. of mouse click:

e-) statistics?

♦time: ♦No. of mouse click:

3-) use a database to find a video about:

a-) sociology?

♦time: ♦No. of mouse click:

b-) organization of body?

♦time: ♦No. of mouse click:

c-) shell programming?

♦time: ♦No. of mouse click:

d-) amines?

♦time: ♦No. of mouse click:

e-) atoms and heat?

♦time: ♦No. of mouse click:

f-) general psychology?

♦time: ♦No. of mouse click:

Please, rank from 1 to 5 regarding the ease of the system, 1 being the easiest and 5 being the full difficult.

♦full easy to use=1 ♦easy to use=2 ♦medium=3

♦difficult=4 ♦full difficult=5

4-) does the library have links to journals?

☐Yes ☐No

5-) does the library have links to magazines?

☐Yes ☐No

6-) can you download a video about Skeletal System?

☐Yes ☐No

7-) can you download an audio about English subject?

☐Yes ☐No

8-) can you get a copy of paper addressed by Elizabeth Alice Honing Curriculum?

☐Yes ☐No

9-) in Psychology subject you will see a video addressed by General Psychology, please, rank from 1 to 5 as the following:

a-) sound?

♦full clear=1 ♦clear=2 ♦medium=3

♦unclear=4 ♦full unclear=5

b-) picture?

♦full clear=1 ♦clear=2 ♦medium=3

unclear=4 full unclear=5

c-) color?

♦full clear=1 ♦clear=2 ♦medium=3

♦unclear=4 ♦full unclear=5

d-) sound?

♦full clear=1 ♦clear=2 ♦medium=3

♦unclear=4 ♦full unclear=5

e-) text?

♦full clear=1 ♦clear=2 ♦medium=3

♦unclear=4 ♦full unclear=5

Post-Test Questionnaire:

Dear Student,

Thanks again for participating in this experiment. This questionnaire gives you an opportunity to tell us your reactions to the system you used. Please, circle a number on the scale to indicate your reactions. Please, write your comments to elaborate on your answers. I will go over your answers with you to make sure that I understand all of your responses.

Thank You.

1-) please rate the ease of use of the Web-Site?

♦full easy=1 ♦easy=2 ♦medium=3

♦difficult=4 ♦full difficult=5

2-) what do you think about the organization of information on the site?

♦full clear=1 ♦clear=2 ♦medium=3

♦unclear=4 ♦full unclear=5

3-) what do you think about the terminology used in the site? Are categories clearly labeled?

♦full clear=1 ♦clear=2 ♦medium=3

♦unclear=4 ♦full unclear=5

4-) is the site visually attractive?

♦full attractive=1 ♦attractive=2 ♦medium=3

♦unattractive=4 ♦full unattractive=5

5-) what is the best feature(s) of the site?

....

....

....

6-) what is the worst feature(s) of the site?

....

....

....

7-) what new content or feature(s) that you would like to see on the site?

....

....

....

8-) can you recover from mistakes easily?

♦full easy=1 ♦easy=2 ♦medium=3

♦difficult=4 ♦full difficult=5

Your comment:

....

....

....

9-) your overall reaction to the system:

♦full satisfied=1 ♦satisfied=2 ♦medium=3

♦unsatisfied=4 ♦full unsatisfied=5

10-) do you feel lost while using the site?

☐Yes ☐No

Your comment:

....

....

....

11-) is the site easy to navigate?

☐Yes ☐No

Your comment:

....

....

....

12-) when you click a button on the Web page, do you expect that the click will lead you to correct answer?

Your comment:

....

....

....

13-) do you have other comments about the Web-Site?

....

....

....

....

Appendix B

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
How many times do yo use Internet in a week?	271.9940	2485.266	.121	.921
Do you prefer any particular day for browsing the Internet?	273.9740	2502.915	.112	.921
Do you Search most of your information requirements from Web site?	273.4140	2513.810	-.149	.921
Are you attacted to Internet of a-)Specific Journals?	274.0340	2500.241	.194	.921
b-)Specific Magazine?	273.9140	2506.479	.027	.921
c-)Specific Digital Library?	273.9740	2502.915	.112	.921
d-)Specific Web-Site?	273.3940	2514.541	-.174	.921
Do you prefer web-site because of a-) availability of your information needs under one site?	273.5940	2501.568	.125	.921
b-) availability of information in short time?	273.5140	2507.401	.007	.921
c-) certainty of getting multimedia?	273.8740	2510.348	-.055	.921
d-) wide searching and browsing?	273.6740	2496.770	.217	.921
Do you use the help facilities when using Web-Site?	273.6140	2500.829	.139	.921
1-a-)Audio English	273.4540	2508.680	-.021	.921
b-)Audio Philosophy	273.4340	2506.760	.024	.921
c-)Audio History	273.4740	2502.723	.113	.921
d-)Audio Geography	273.5140	2508.487	-.016	.921
e-)Audio Statistics	273.5140	2509.425	-.037	.921
f-)Download iTunes	273.5340	2511.547	-.081	.921
2-a-)Video Sociology	273.5940	2510.110	-.049	.921
b-)Video Org of Body	273.4540	2508.680	-.021	.921
c-)Video Shell Programming	273.5340	2511.967	-.090	.921
d-)Video Amines	273.4140	2507.949	-.004	.921
e-)Video Atoms Heart	273.4140	2494.389	.332	.921
f-)Video Gen Psycology	273.4140	2505.157	.065	.921

b-)Video Skeletal Sys	273.4340	2516.523	**-.209**	.921
3-)Ease of Learn	272.9740	2522.355	**-.142**	.922
4-)Learning Effort	271.0940	2507.914	**-.013**	.922
Dose the library have a paper copy of a-) Education History?	273.7140	2493.375	**.284**	.921
b-) Different Place, Different People?	274.0140	2521.625	**-.341**	.922
c-) What use in economic theory?	273.8940	2526.071	**-.388**	.922
d-) History of social Theory?	273.7940	2511.211	**-.070**	.921
e-) Teaching English to the World?	273.5740	2491.812	**.328**	.921
Pleas, rank the ease of the System1	272.1340	2465.440	**.424**	.920
Use a database to find an Audio about a-) English Subject	270.6340	2480.166	**.360**	.920
b-) Philosophy	270.5340	2464.306	**.528**	.920
c-) History	270.5940	2458.625	**.483**	.920
d-) Geography	270.3740	2475.352	**.474**	.920
e-) Satisties	270.6140	2458.580	**.528**	.920
Pleas, rank the ease of the System2	272.4740	2506.498	**.016**	.921
Use a database to find a Video about a-) Sociology	269.5340	2484.265	**.357**	.920
b-) Organization of Body	269.6540	2484.618	**.312**	.920
c-) Shell Programming	269.5140	2489.719	**.356**	.921
d-) Amines	269.5140	2486.878	**.251**	.921
e-) Atoms and Heart	269.2940	2502.101	**.105**	.921
f-) General Psychology	269.4540	2492.795	**.205**	.921
Please, rank the ease of the System3	272.2340	2512.427	**-.072**	.921
Does the library have links to the Journals?	273.5540	2503.120	**.096**	.921
Does the Liubrary have ilnks to the Magazines?	273.5740	2506.228	**.030**	.921
Can you download a video about Skeletal System?	273.4540	2511.897	**-.096**	.921
Can you download an audio about English Subject?	273.4740	2501.539	**.140**	.921
Can you copy a papre	273.5340	2507.155	.012	.921

addressed by Elizabeth Alice Honing Curriculum?				
In Psychology subject you saw a video addressed by General Psychology, please rank a-) Sound	272.3740	2503.013	.078	.921
b-) Picture	273.0740	2493.228	.195	.921
c-) Color	272.7740	2528.867	-.272	.922
d-) Text	272.6140	2509.167	-.023	.921
Please, rate the ease of the Use of the Web-Site	272.8140	2487.366	.256	.921
What do you think about the organization of the information of the site?	272.7140	2517.742	-.128	.922
What do you think about the terminology used in the site?	272.5740	2513.620	-.081	.922
Is the site visually attractive?	272.8740	2523.197	-.188	.922
Can you recover from the mistakes easily?	272.5740	2529.077	-.223	.922
Your overall reaction to the system	272.4740	2485.262	.251	.921
Do you feel lost when using the site?	273.8940	2483.769	.510	.920
Is the site easy to navigate?	273.5940	2501.384	.129	.921
EduTime	270.4640	2304.823	.752	.916
DiffPicPeoTime	270.4940	2337.421	.668	.917
EconomicTheoryTime	270.3340	2331.140	.742	.917
HistoryofSocialTheoryTime	270.7140	2321.742	.889	.916
TeachingEngtoWorldTime	270.8680	2310.261	.747	.916
EnglishTime	269.4540	2159.321	.866	.914
PhilosophyTime	269.0540	2170.427	.880	.914
HistoryTime	269.2340	2206.276	.815	.915
GeographyTime	269.0680	2201.390	.834	.915
StatisticsTime	269.1140	2170.400	.867	.914
SociologyTime	267.1540	2153.716	.865	.914
OrganizationBodyTime	268.0960	2312.475	.672	.917
ShellProgrammingTime	267.2360	2150.453	.851	.915
AminesTime	267.0760	2162.434	.843	.915
AtomsHeartTime	267.5760	2218.252	.883	.914
GeneralPsychologyTime	267.5140	2194.368	.857	.914

Mouse Clicka	271.5540	**2512.704**	**-.063**	.922
Mouseb	272.0740	2535.155	**-.295**	.922
Mousec	272.0940	2537.123	**-.396**	922
Moused	272.1740	2501.260	**.120**	.921
Mousee	271.7140	2498.277	.079	.921

Table1. Reliability

Appendix C

Web-Site Experience:

Dear Student,

The goal of this test is to determine your Web site experience. I will ask you a series of questions and would like you to answer them as important as for the next tasks.

I thank you.

♦Name:
♦Age:
♦Sex: ☐Male: ☐Female:
♦E-Mail Address:

1-) how many times do you use Internet in a week?

☐1 time ☐2times ☐3times ☐over

2-) do you prefer any particular day for browsing the Internet Web sites?

☐Yes ☐No

If yes, specify the day you prefer:

☐Saturday ☐Sunday ☐Monday ☐Tuesday ☐Wednesday
☐Thursday ☐Friday

3-) do you search most of your information requirements from Web site?

☐Yes ☐No

4-) are you attracted to the Internet of:

a-) specific Journals?

☐Yes ☐No

b-) specific Magazines?

☐Yes ☐No

c-) specific Digital Libraries?

☐Yes ☐No

d-) specific Web-site?

☐Yes ☐No

If yes, specify the Web-site you visit?

☐Yahoo ☐ScienceDirect ☐Gigabedia ☐Google ☐Others

5-) do you prefer Web-Set because of:

a-) availability of your information needs under one site?

☐Yes ☐No

b-) availability of information in short time?

☐Yes ☐No

c-) certainty of getting multimedia?

☐Yes ☐No

d-) wide searching and browsing?

☐Yes ☐No

6-) do you use the help facilities when using Web-Site?

☐Yes ☐No

Appendix D

Total Variance Explained

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	15.944	18.757	18.757	11.929	14.034	14.034
2	15.152	17.825	36.583	9.843	11.580	25.614
3	9.940	11.694	48.276	9.010	10.600	36.214
4	6.762	7.956	56.232	7.610	8.953	45.168
5	4.605	5.418	61.650	5.381	6.331	51.499
6	3.293	3.874	65.524	4.881	5.742	57.241
7	3.175	3.735	69.260	4.165	4.900	62.141
8	2.595	3.053	72.312	3.709	4.364	66.505
9	2.329	2.740	75.053	3.267	3.844	70.349
10	2.309	2.716	77.769	2.960	3.483	73.832
11	1.883	2.215	79.984	2.480	2.918	76.750
12	1.822	2.144	82.128	2.354	2.769	79.518
13	1.729	2.034	84.162	2.018	2.374	11.892
14	1.398	1.645	85.807	1.786	2.101	83.993
15	1.192	1.402	87.209	1.722	2.026	86.019
16	1.114	1.310	88.519	1.600	1.882	87.901
17	1.051	1.237	89.756	1.577	1.855	89.756
18	915	1.077	90.833			
19	853	1.003	91.836			
20	781	.918	92.754			
21	.775	911	93.665			
22	634	.746	94.411			
23	558	.657	95.068			
24	.534	.629	95.697			
25	479	.563	96.260			
26	417	.491	96.751			
27	.363	.427	97.178			
28	325	.382	97.560			
29	.306	.360	97.920			
30	.275	.324	98.243			
31	229	.270	98.513			
32	190	.224	98.737			
33	166	.196	98.933			
34	153	.180	99.113			
35	.137	162	99.274			

36	.109	.129	99.403
37	.101	.119	99.522
38	.090	.105	99.627
39	.068	.080	99.707
40	.062	.073	99.780
41	.052	.062	99.842
42	.039	.046	99.888
43	.034	.040	99.929
44	.021	.025	99.954
45	.019	.022	99.976
46	.010	.012	99.988
47	.005	.006	99.994
48	.004	.005	99.999
49	.001	.001	100.000
50	2.133E-15	2.509E-15	100.000
51	1.713E-15	2.015E-15	100.000
52	1.597E-15	1.879E-15	100.000
53	1.390E-15	1.636E-15	100.000
54	1.294E-15	1.522E-15	100.000
55	1.110E-15	1.306E-15	100.000
56	9.523E-16	1.120E-15	100.000
57	8.909E-16	1.048E-15	100.000
58	7.674E-16	9.028E-16	100.000
59	6.643E-16	7.815E-16	100.000
60	6.260E-16	7.364E-16	100.000
61	4.898E-16	5.762E-16	100.000
62	4.375E-16	5.147E-16	100.000
63	3.533E-16	4.156E-16	100.000
64	2.417E-16	2.843E-16	100.000
65	1.630E-16	1.917E-16	100.000
66	1.127E-16	1.326E-16	100.000
67	1.916E-17	2.254E-17	100.000
68	-4.691E-18	-5.518E-18	100.000
69	-5.392E-17	-6.343E-17	100.000
70	-7.796E-17	-9.172E-17	100.000
71	-1.375E-16	-1.617E-16	100.000
72	-1.620E-16	-1.906E-16	100.000
73	-2.181E-16	-2.565E-16	100.000
74	-3.562E-16	-4.191E-16	100.000
75	-4.840E-16	-5.694E-16	100.000

76	-5.034E-16	-5.922E-16	100.000
77	-6.395E-16	-7.523E-16	100.000
78	-7.335E-16	-8.629E-16	100.000
79	-8.378E-16	-9.856E-16	100.000
80	-9.265E-16	-1.090E-15	100.000
81	-9.983E-16	-1.175E-15	100.000
82	-1.031E-15	-1.213E-15	100.000
83	-1.208E-15	-1.421E-15	100.000
84	-1.488E-15	-1.750E-15	100.000
85	-2.566E-15	-3.019E-15	100.000

Extraction Method: Principal Component Analysis.

Table2. Factor Loading

Appendix E

LEARNABILITY EVALUATION:

The researcher builds the map of steps to evaluate the learnability for BDL.

MAP OF STEPS:

The purpose of map of steps is to evaluate the learnability of BDL. Since the students completed the training for using BDL, they have enough experience for navigating, browsing, searching, downloading several audios, videos, and copying text, image... etc. They answered the questionnaire, which built to evaluate their information to use BDL, its usability, and learning activities. The students performed many tasks such as listening audios, watching videos, and reading some PDF papers. They wrote some abstracts and notes for the specific goal of collaborative learning, participated in small groups as peers and discussed their information together, and entered the final exam to evaluate their abilities, and understanding the knowledge. Therefore, the researcher establishes the new way, which is a naïve way to evaluate students' learnability. This new method called a map of steps. In this method, the researcher demonstrates all the procedures for navigating BDL moving from one link to others, prints the screen for each step, and put a number opposite each link. However, the researcher rewrites the part of the previous questionnaire that students answered its questions with some modifying.

Usually, the classic types of questions are the multi-choice questions with string or numeric answer. These questions are most important to measure the learnability of each participant. Each question requests from the students to follow the numbers in the map to get the correct answers and put the correct mark opposite the question number in the answer paper. For example, put the correct mark in the front of the correct answer in the following questions.

1-) use a database to find an audio about: a-) English subject?

- 1 2 4 5 27
- 1 2 3 5 27
- 1 2 4 6 27

The students in this method will respond to the exam depending in their memory to remember each step they learned in their learning. At the end of this exam the researcher will ask the students to rank the ease of learn and learning effort (see figure1 bellow).

Figure1. An example of answer question of BDL using Map of step

Dear Student,

Would you kindly fill the enclosed evaluation form for digital library's Web Site?

We hope your response together with our own assessment will contribute to the improvement of our future programs. I will ask you a series of questions and would like you to look for the answer. The classic type of questions is the multi-choice questions with string or numeric answer. Do not worry if you cannot find the answer every time. Please, remember that we are testing the learnability of the DL and this is not a test you. *For example, put the correct mark (√) in the front of the correct answer in the following questions.*

1-) use a database to find an audio about a-) English subject?

- *1 2 4 5 27 (√)*
- *1 2 3 5 27*
- *1 2 4 6 27*

The whole test should take less than an hour.

I Thank You.

1-) use a database to find an audio about

a-) English subject?

- 1 2 4 5 27
- 1 2 3 5 27
- 1 2 4 6 27

b-) Philosophy?

- 1 2 3 5 39
- 1 2 3 48 39
- 1 2 4 5 39

c-) History?

- 1 2 4 5 36
- 1 2 4 50 36
- 1 2 4 6 36

d-) Geography?

- 1 2 4 5 28
- 1 2 4 5 29
- 1 2 3 6 28

e-) Statistics?

- 1 2 3 5 47
- 1 2 4 5 47
- 1 2 60 61 47

f-) Downloading iTunes U software?

- 1 2 4 5 49 50
- 1 2 3 5 48 49
- 1 2 4 5 48 49

2-) use a database to find a video about

a-) Sociology?

- 1 2 3 66 60 61
- 1 2 3 66 63 61
- 1 2 4 66 60 61

b-) Organization of body?

- 1 2 3 66 48 51
- 1 2 4 66 50 51
- 1 2 3 66 50 51

c-) Shell programming?

- 1 2 3 66 51 53
- 1 2 4 66 52 53
- 1 2 3 66 52 53

d-) Amines?

- 1 2 3 66 65 55
- 1 2 3 66 54 55
- 1 2 4 66 54 55

e-) Atoms and Heat?

- 1 2 4 66 56 57
- 1 2 3 66 56 57
- 1 2 3 66 55 57

f-) General Psychology?

- 1 2 3 66 58 59
- 1 2 4 66 58 59

- 1 2 3 66 57 59

h-) Skeletal System?

- 1 2 3 66 62 63
- 1 2 4 66 58 63
- 1 2 3 66 59 63

Please, rank from one to five regarding the ease of learns DL, 1 being the easiest and 5 being the full difficult.

- Full ease to learn=1
- Ease to learn=2
- Medium=3
- Difficult=4
- Full difficult=5

Appendix F

THE NORMALITY OF INSTRUMENT

One-Sample Kolmogorov-Smirnov Test

Overall Model	**Effec**	**EffiT**	**EffM**	**Satis**	**Lrnbty**	**InfoG**	**InfoS**	**ACnsm**
Kolmogorov-	1.010	2.089	2.624	.845	1.369	2.432	2.582	1.445
Smirnov Z Asymp. Sig. (2-tailed)	.260>.10	.000<.01	.000<.01	.474>.10	.047<.05	.000<.01	.000<.01	.031<.05
Experience	**1MF**	**AGE**	**exp3**	**exp4**	**exp5**	**exp6**	**exp7**	**exp8**
Kolmogorov-	3.782	2.884	1.546	3.330	3.463	3.526	3.122	3.330
Smirnov Z Asymp. Sig. (2-tailed)	.000<.01	.000<.01	.017<.05	.000<.01	.000<.01	.000<.01	.000<.01	.000<.01
	exp9	**exp10**	**exp11**	**exp12**	**exp13**		**exp14**	
	3.526	2.834	3.122	2.979	2.542		2.762	
Kolmogorov-Smirnov Z Asymp. Sig. (2-tailed)	.000<.01	.000<.01	.000<.01	.000<.01	.000<.01		.000<.01	
Learnability	**Eng**	**Philo**	**HisLrn**	**GeoLrn**	**StatsLrn**	**Dwn**	**SoLrnV**	**OrBodLrnV**
Kolmogorov-	3.330	3.397	3.262	3.122	3.122	3.051	2.834	3.330
Smirnov Z Asymp. Sig. (2-tailed)	.000<.01	.000<.01	.000<.01	.000<.01	.000<.01	.000<.01	.000<.01	.000<.01
Learnability	**ShProLrnV**	**AmLrnV**	**AHrtLrnV**	**GPsLrnV**	**SkLrnV**	**EOLrn**	**LrnEff**	
Kolmogorov-	3.051	3.463	3.463	3.463	3.397	1.489	2.848	
Smirnov Z Asymp. Sig. (2-tailed)	.000<.01	.000<.01	.000<.01	.000<.01	.000<.01	.024<.05	.000<.01	
Effec&Effi and Satis	**PapEdu**	**PapDff**	**PapUseco**	**PapHis**	**PapTE**	**RSys1**	**tm1a**	**tm1b**
Kolmogorov-	2.396	3.463	3.051	2.689	2.907	1.784	2.043	1.496
Smirnov Z Asymp. Sig. (2-tailed)	.000<.01	.000<.01	.000<.01	.000<.01	.000<.01	.003<.01	.000<.01	.023<.05
Effec&Effi and Satis	**tm1c**	**tm1d**	**t1e**	**mosa**	**mosb**	**mosc**	**mosd**	**mose**
Kolmogorov-	1.582	1.699	1.357	2.656	2.389	2.149	2.616	1.268
Smirnov Z Asymp. Sig. (2-tailed)	.013<0.5	.006<.01	.050=P=.05	.000<.01	.000<.01	.000<.01	.000<.01	.080>.10
Effi & Satis2	**English**	**Philosophy**	**History**	**Geography**	**Statistics**	**RSys2**	**tm2a**	**tm2b**
Kolmogorov-	2.900	2.489	3.019	3.061	2.596	2.117	2.356	2.376
Smirnov Z Asymp. Sig. (2-tailed)	.000<.01	.000<.01	.000<.01	.000<.01	.000<.01	.000<.01	.000<.01	.000<.01
Effi & Satis2	**tm2c**	**tm2d**	**tm2e**					

Kolmogorov-	2.106	2.373	1.909					
Smirnov Z Asymp. Sig. (2-tailed)	.000<.01	.000<.01	.001<.01					
Effi & Satis3	VSo	VOrBod	VSPro	VAms	VAHrt	VGPscho	RSys3	tm3a
Kolmogorov-	2.744	3.011	2.855	3.137	2.971	3.049	1.921	1.568
Smirnov Z Asymp. Sig. (2-tailed)	.000<.01	.000<.01	.000<.01	.000<.01	.000<.01	.000<.01	.001<.01	.015<.05
Effi & Satis3	tm3b	tm3c	tm3d	tm3e	tm3f			
Kolmogorov-	.992	1.548	1.610	1.133	1.194			
Smirnov Z Asymp. Sig. (2-tailed)	.279>.10	.017<.05	.011<.05	.154>.10	.116>.10			
Active Learning	Jor	Mgzn	DwnV	DwnA	CpyP	Snd	Pctr	Colr
Kolmogorov-	2.979	2.907	3.330	3.262	3.051	2.460	1.670	1.782
Smirnov Z Asymp. Sig. (2-tailed)	.000<.01	.000<.01	.000<.01	.000<.01	.000<.01	.000<.01	.008<.01	.003<.01
Active Learning	Txt							
Kolmogorov-	2.048							
Smirnov Z Asymp. Sig. (2-tailed)	.000<.01							
Post-Test	EOU	OrgInfo	Trmnlogy	Attrct	Mis	Ractn	Lost	Nvg1
Kolmogorov-	2.251	1.629	1.946	2.233	1.999	2.239	3.051	2.834
Smirnov Z Asymp. Sig. (2-tailed)	.000<.01	.010=P=.01	.001<.01	.000<.01	.001<.01	.000<.01	.000<.01	.000<.01

Table (1) Normal Distribuion

Vijay Gupta (1999)[18] indicated the rules for normal distribution using One-Sample Kolmogorov-Smirnov Test that are as follow: If Sig. is less than 0.10, then the test is significant at 90% confidence (equivalently, the hypothesis that the distribution is normal can be rejected at the 90% level of confidence). Some statisticians consider this criterion too "loose". If Sig. is less than 0.05, then the test is significant at 95% confidence (equivalently, the hypothesis that the distribution is normal can be rejected at the 95% level of confidence). This is the standard criterion used. If Sig. is less than 0.01, then the test is significant at 99% confidence (equivalently, the hypothesis that the distribution is non-normal can be rejected at the 99% level of confidence). This is the strictest criterion used. You should memorize these criteria, as nothing is more helpful in interpreting the output from hypothesis tests (including all the tests intrinsic to every regression and ANOVA analysis). Therefore, depending in the rules the researcher inferred that the distribution of the learnability of using the digital library and the ease of learn were non-normal (because, P=0.047<0.05 and P=0.024<0.05 respectively) but the distribution of the learnability predictors were normal (see table (1) above). Similarly, the distribution of the active consuming was non-normal (because, P=0.031<0.05) but the distribution of its predictors were normal. The distribution of the predictors such as exp3 (P=0.017<0.05), tm1b (P=0.023<0.05), tm1c (P=.013<0.05), tm3a (P=0.015<0.05), tm3c (P=0.017<.05), and tm3d (P=0.011<0.05) were non-normal in other words the distribution of the reminding predictors of the learning activities and usability and their attributes were normal.

The following figures demonstrate some of these normality between the usability attributes and learning activites.

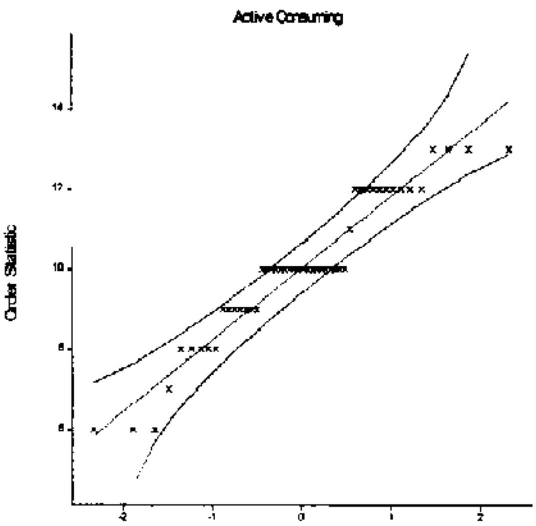


Figure1. Active Consuming Probability Plots

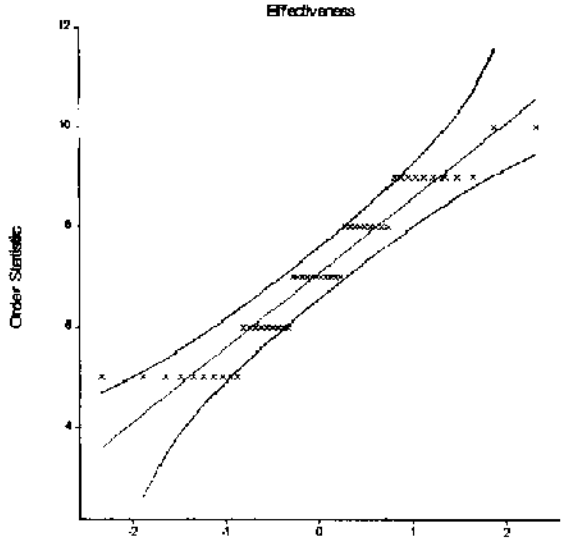


Figure.2 Effectiveness Probability Plots

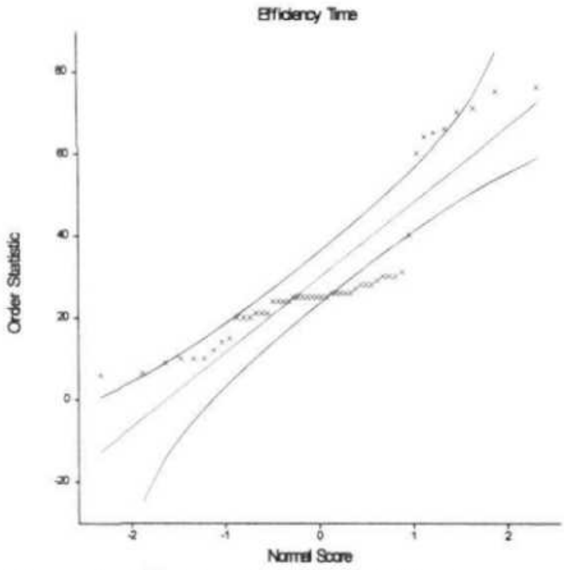


Figure.3 Efficiency Time Probability Plots

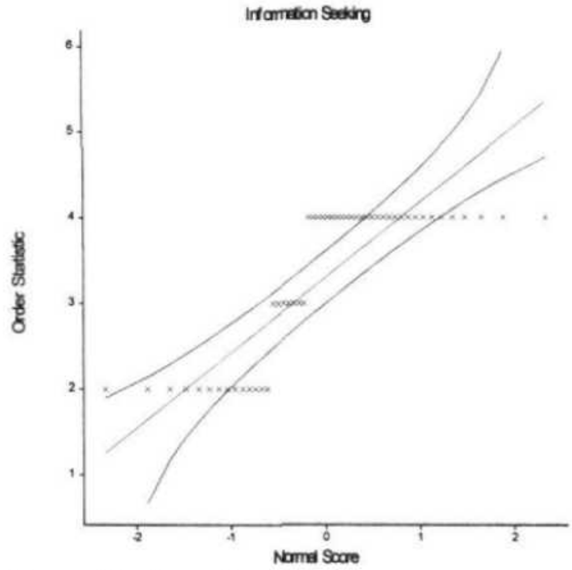


Figure.5 Information Seeking Probability Plots

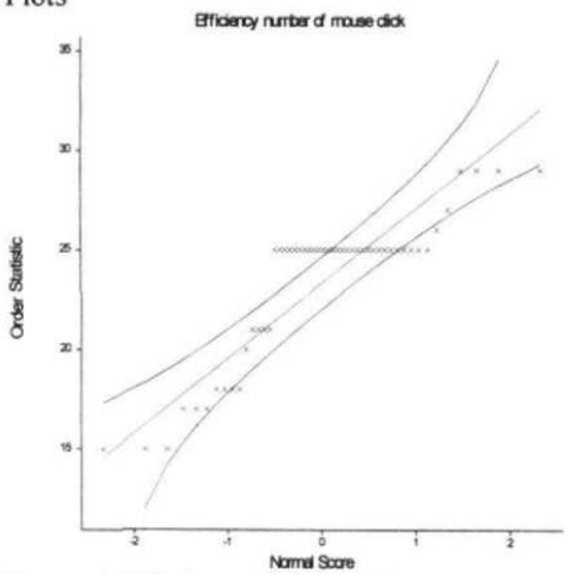


Figure.4 Efficiency Number of Mouse Click Probability Plots

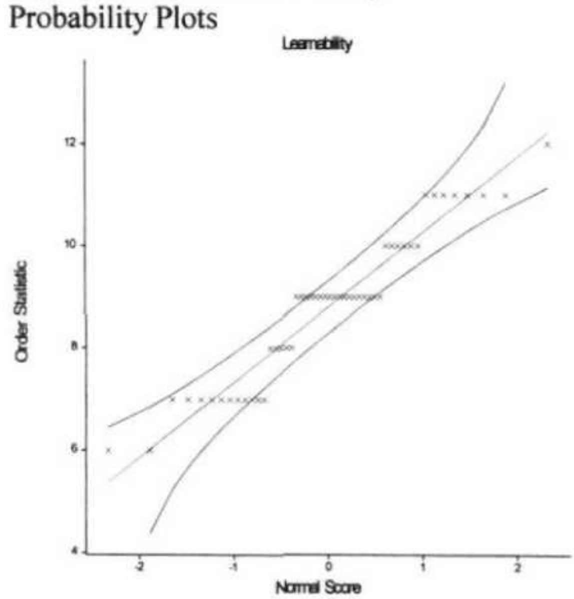


Figure.6 Learnability Probability Plots

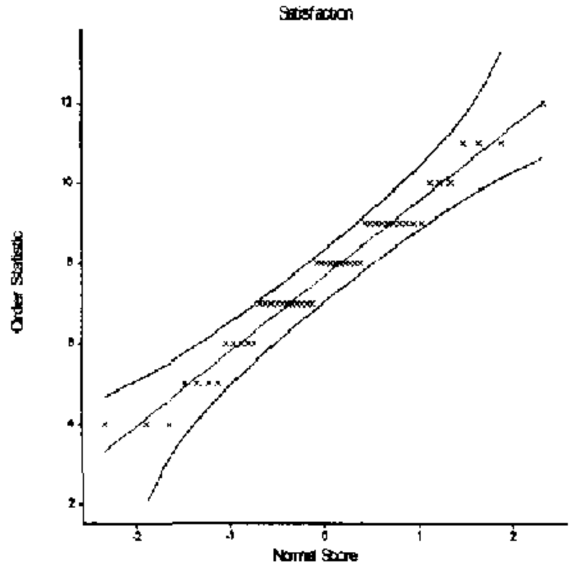


Figure.7 Satisfaction Probability PlotS

Finally, normality can be assessed more formally with the help of a *quantile-quantile probability plot* (Q-Q plot); this involves a plot of the quantiles expected from a standard normal distribution against the observed quantiles. Such a plot for the observations in each group is shown in the Figures above. A graph in which the points lie approximately on the reference line indicates normality. Points above the line indicate that the observed quantiles are lower than expected and vice versa. Therefore, Active Consuming data find that the very small and very large quantiles are smaller than would be expected (Sabine & Brian, 2004)[6].

Appendix G

CFA Three Factor Completely Standardized Factor Loadings Variance Extracted and Reliability Estimates

Table (1). Factor Loadings, Variance Extracted, and Reliability

	Usability	Active Learning		Item Reliability		Delta
EFFEC	.69			0.4761		0.52
EFFIT	.60			0.36		0.64
EFFIM	.83			0.6889		0.31
SATIS	.58			0.3364		0.66
LRNBTY	.96			0.9216	2.783	0.08
INFOG		.64		0.4096		0.59
INFOS		.97		0.9409		0.06
ACNSM		.66		0.4356	1.7861	0.56
	(2.783/5)*100	(1.7861/3)*100				
Variance Extracted	55.66	59.54				
Construct Reliability	0.86	0.81				

Formula for Variance Extracted

$$VE = \frac{\sum_{i=1}^{n} \lambda_i^2}{n}$$

In the formula above the λ represents the standardized factor loading and i is the number of items. So, for n items, AVE is computed as the sum of the squared standardized factor loadings divided by the number of items, as shown above.

A good rule of thumb is an AVE of .5 or higher indicates adequate convergent validity. An AVE of less than .5 indicates that on average, there is more error remaining in the items than there is variance explained by the latent factor structure you have imposed on the measure.

An AVE estimate should be computed for each latent construct in a measurement model.

Calculated Variance Extracted (AVE):

Usability Construct=0.4761+0.3600+0.6889+0.3364+0.9216=2.783/5=0.5566

Active Learning Construct=0.4096+0.9409+0.4356=1.7861/3=0.5954

$$CR = \frac{(\sum_{i=1}^{n} \lambda_i)^2}{(\sum_{i=1}^{n} \lambda_i)^2 + (\sum_{i=1}^{n} \delta_i)}$$

<u>Construct reliability</u> – is computed from the sum of factor loadings (λi), squared for each construct and the sum of the error variance terms for a construct (δi) using the above formula. Note: error variance is also referred to as delta.

The rule of thumb for a construct reliability estimate is that .7 or higher suggests good reliability. Reliability between .6 and .7 may be acceptable provided that other indicators of a model's construct validity are good. A high construct reliability indicates that internal consistency exists. This means the measures all are consistently representing something.

Discriminante Validity

Table (2) Squared Multiple Correlations

	Estimate (IC)	Square of Estimate (SIC)
ACNSM	.216	0.0467
INFOS	.934	0.8723
LRNBTY	.001	0.00001
SATIS	.285	0.0812
EFFM	.182	0.0331
EFFIT	.026	0.0007
INFOG	.412	0.1697
EFFEC	.478	0.2285

Table (3) Discriminant Validity

	AVE	SIC
Usability	0.5566	0.0467, 0.1697, 0.08723
Active_Learning	0.5954	0.00001, 0.0812, 0.0331, 0.0007, 0.2285

All variance extracted (AVE) estimates in the above table are larger than the corresponding squared interconstruct correlation estimates (SIC). This means the indicators have more in common with the construct they are associated with than they do with other constructs. Therefore, the three construct CFA model demonstrates discriminant validity.

The table 3 above showed the discriminant validity. Therefore, two construct CFA model demonstrated the discriminant validity.